Use of Pesticides and Health Hazards in the Plantation Sector

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F O R E W O R D

From 17 to 18 July 1987 and from 17 to 19 December 1987, the Friedrich-Ebert-Stiftung in collaboration with the Congress Labour Foundation (CLF) conducted two seminars in Colombo and Nuwara-Eliya/Talawakelle, on "Use of Pesticides and Health Hazards in the Plantation Sector". Besides independent Scientists and Labour Lawyers, representatives of Plantation Workers' Unions, Research Institutes, Government Institutions, Universities, Corporations and Private Companies involved in production, distribution and use of pesticides, also participated in these Seminars to gather necessary information and to exchange views on the subject. One objective of the Seminar was to create an awareness among those people who deal with the production and distribution of pesticides and their use to increase productivity, profits and outputs, that pesticides have negative side effects on human beings and the environment and that a special responsibility is demanded of them. The other objective was to make those people who are concerned with the prevention of occupational accidents and diseases and with the improvement of living and working conditions of the estate workers and their families more conscious of and sensitive to the problems of estate workers in relation to the use of pesticides and their harmful effects.

a spontaneous outcome of the first seminar an Advisory Committee was established, consisting of Trade Unionists, Scientists and Government Officials, which drafted two brochures on "First Aid for Pesticide Poisoning" and "Safe Use of Pesticides" in all three official languages. They are already printed and distributed among the plantation workers. The Committee is presently engaged on a documentation on "Pesticides in Sri Lanka" which will be published in the near future.

The Advisory Committee also recommended the publishing of the papers presented at these two Seminars, in order to give those concerned and interested members of the public an opportunity to participate in the results, as well as to encourage them to take part in the discussion. We followed this recommendation and I hope that the present book contributes to the actual discussion about the use of pesticides in Sri Lanka and Third World countries.

The book entitled :"Use of Pesticides and Health Hazards in the Plantation Sector" contains contributions from different authors with diverse professional and occupational backgrounds : Chemists, Biologists, Economists, Agriculturists and Medical Men, both from the public and private sectors. Several papers deal with the general problem of pesticides, some focus on the whole agricultural economy while others concentrate only on the plantation sector.

I wish to thank the authors for their co-operation in contributing towards this publication. Further, I also wish to thank the CLF and its Executive Director, Mr P Devaraj, for the co-operation in organising the Seminars. I am also grateful to Mr T Kandasamy, who did the tedious work of editing, Mrs E A Thiruppathy, who undertook the necessary proofreading, Mr Nizam Deen for supplying the artwork for the various diagrams and tables and last but not least, I thank my staff for supporting me in completing this book.

GERD BOTTERWECK
Friedrich-Ebert-Stiftung

Colombo, October 1988

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CHEMICALS, MAN AND BIOSPHERE

by

T. Kandasamy

Many of us perhaps think that chemicals are the products of chemical industry, but we do not realize that the world is chemical in nature and that everything we look at has some chemical component. The food we eat consists of carbohydrates, proteins, fats and minerals; the clothes we wear are made of natural and synthetic fibres. The knowledge on chemical substances is of recent origin, for in the early days the science of nutrition or investigations into the composition of matter were not the interests of man. Chemists learned that before they made new substances they must first discover what ordinary things were made of. This knowledge has led to the production of many chemicals - so many that people are frightened by the sea of chemicals around them.

Today there are over 6 million chemicals and of this number some 60,000 are in common use. Each year about 1,000 new chemicals are brought into the market although all of them may not be used. The annual trade in chemicals between major producing countries is worth one hundred thousand million US-Dollars. In November 1977 the Chemical Abstract Service (CAS) registered 4,039,507 distinct chemicals which had been mentioned in the literature since 1965. On 24th February 1983 the CAS registered its six millionth chemical.

Chemicals are considered dangerous material produced and disposed of by the chemical industry causing cancer, deleterious effects on progeny and environmental changes. This is not altogether true. Chemicals have in the last few decades dramatically changed many of our activities. They have contributed considerably to increased food production through the proper use of fertilizers and pesticides. They have been used in the food industry for processing and preservation. Many pharmaceutical products, which are chemicals, have been manufactured and put into use. These chemicals have changed man's abilities to treat diseases and also prevent diseases. Many household products and other consumer goods have been introduced which are being appreciated and enjoyed by modern society because they have added considerably to the quality of life. It will, therefore, be observed that chemicals have both beneficial as well as hazardous aspects and the main factor is proper knowledge of these chemicals and of their uses.

Chemical pollutants are found on the earth's surface, in the seas and in the air. These chemicals find their way to these places from the chemical industry, by the use of fertilizers and pesticides and from day to day usage. Chemical pollutants are of major concern in the Mediterranean region. A study was initiated at the UN level by United Nations Environment Programme (UNEP). Metals, PCBs and other chemicals are also found as environmental contaminants. Activities such as combustion of fossil fuel for heating, energy production and other industrial activities produce significant emissions of sulphur-dioxide and other sulphur compounds. Combustion and industrial processes are also prime sources of particulate emissions. Vehicles also produce lead and unburnt particles and gases from their exhausts.

Sulphur-dioxide and suspended particulate matter are the most widely monitored air pollutants. National sampling networks exist in many of the industrialized countries. It is known that these air pollutants are transported over many hundreds of kilometres through the atmosphere. It has been shown that emissions from the most industrialized areas of Europe and North America are the sources of polluted air and precipitation in areas far distant from emission sources. These sulphur and nitrogen compounds cause acid precipitation normally called "acid rains" and this has led to the acidification of water courses in large areas of Europe and North America. The areas most affected are Canada and Sweden. In Southern Norway 13,000 sq kilometres have become devoid of fish in recent decades. Studies indicate that the causes of acidification other than by atmospheric means are of little significance.

Chlorofluoro-carbons which are used as propellant constituents in the manufacture of hair sprays, deodorants and antiperspirants and in refrigerators have had serious effect on the atmospheric ozone layer. The World Meteorological Organization (WMO) issued a statement on 26th November 1978 on "Modification of the Ozone Layer due to Man's Activities." The statement pointed out that the amount of ozone in the atmosphere is determined not only by photo-chemical reactions between oxygen atoms but also by reactions involving traces of gases such as oxides of nitrogen and chlorine. The concentration of these gases in the stratosphere could be affected by various human activities notably high flying aircraft, the use of chlorofluoromethanes (freon) in aerosol sprays and refrigerators and the use of agricultural fertilizers. The statement also mentioned that the long term steady-state effect of a continued release of chlorofluoromethane into the atmosphere at the 1972 level would reduce on the average the ozone level by 10 percent. A 10 percent reduction in ozone would result in a 20 percent increase in the Ultra-violet radiation reaching the earth's surface. These studies brought in legislation in many countries with regard to the use of chlorofluorocarbons. One such legislation is worth noting. Under the Pollution Act 1970, the Minister of Public Health and Environmental Protection, Netherlands published a decree on October 30, 1978 to limit the use of chlorofluorocarbon. The decree forbids anyone to have available for sale, sell, deliver or advertise spray cans containing dichlorofluoro-methane or trichlorofluoromethane without a warning label which in effect is as follows:

> "WARNING: - Contains a chlorofluoromethane which may be harmful to the environment and human health by diminishing the ozone in the stratosphere".

This decree does not apply to spray cans produced for export and for certain pharmaceutical purposes.

A number of scientific assessments have been made the most recent of which is by the UNEP Co-ordinating Committee on the ozone layer during the meeting held in Geneva in 1983. The Committee stated that the ozone layer can be affected by a number of man-made and natural processes in a complex manner. At the present level of release of chlorofluoromethane there would be a reduction of total ozone layer column by about 3 - 5 percent compared to the 5 - 10 percent estimated earlier. By taking a note for the need to reduce the emission of chlorofluoromethane where practicable in the sectors of refrigerators, foam plasters and solvents the Committee prepared an action programme.

It has been said that the increased carbon-dioxide content of the atmosphere due to the mismanagement of the environment by mankind, is likely to increase the earth's temperature over the years. Studies are now being carried out.

There are about 80 metals found generally on earth. Most of these metals are found only in trace amounts in the biosphere and in biological material. Iron and Aluminium, which find extensive applications in industry and daily life, are perhaps the major components of the earth's crust. The ecological consequences of the dispersion of these two elements in the environment have not posed any serious health problems. There are at least some twenty metals which do give rise to well recognized toxic effects in man. These elements include arsenic, antimony, cadmium, lead and mercury which have been subjected to extensive studies due to reported cases of poisoning. Prescribing limits for arsenic in foods was recommended by the Royal Commission on Arsenic in 1903. In 1900 there was a serious outbreak of arsenical poisoning in Lancashire and Staffordshire due to beer made with glucose contaminated with arsenic. The total number of cases was estimated at over 6,000 and at least 70 persons died. The poisoning by mercury compounds is known as Minamata disease where people of the area ate fish containing methylmercury, the compound was formed by the discharge of mercury residues to the lake. Then there is the recent outbreak of Itai-Itai disease in Japan following the consumption of rice containing high levels of cadmium. The presence of lead in the environment has led to a number of cases of poisoning. In this country too there have been a number of such cases.

The changes in the flavour and quality of foods due to mould growth have long been recognized. Some of these changes are desirable in that a pleasing flavour is imparted to the food as in certain varieties of cheese. In most cases, mould causes unwanted changes in foods producing unpleasant flavours and odours. These moulds produce toxins known as mycotoxins which have been identified as chemicals and some of these toxins have been synthesized. Ergot poisoning from eating cereal grain particularly rye infected with the parasitic fungus Clariceps Purpurea has occurred over the centuries causing suffering and death to many people. The main components of ergot responsible for ergotism diseases were identified as alkaloids in 1975. Incidentally these alkaloids are useful in medicine and pure compounds have been manufactured and used for several years. A combination of circumstances in the early 1960's changed the attitude towards moulds in food and feed grains. The reason for this change was the outbreak of turkey disease in England which resulted in the death of thousands of young turkeys. The disease was traced to a mouldy peanut cake in the ration. The mould responsible for this disease was identified as Aspergillus Flavous. The toxic metabolites were isolated and identified as chemical compounds, aflatoxins B1, B2, G2 and G1. Acute toxicity is rare in the case of humans. However, there has been a recent epidemic of fatal hepatitis in several tribal villages in the States of Gujerat and Rajasthan in Western India in the Autumn of 1974 due to eating of maize, (a principal item in the diet) heavily contaminated with aflatoxins ranging in concentration from 0.25 to 15.6 mg/kg (mean 6.0 mg/kg). Nearly 400 people were affected with a mortality rate of 20 percent. Aflatoxin contamination can occur in the growing, harvesting, storage and processing of an agricultural commodity particularly cereals and pulses. The mould has been traditionally considered to be a storage mould. There are high risk commodities such as peanuts and maize.

Chemicals, toxic metals and chemicals produced by moulds found in the environment can contaminate food and cause health hazards. There are in a similar manner, a large number of other chemicals like fertilizers and pesticides that can also cause health hazards to man and animals. In the case of contaminants in food the Food and Agriculture Organization (FAO) and Word Health Organization (WHO) have shown concern. National Governments have fixed maximum limits for the presence of chemicals. The FAO/WHO had started a joint programme in 1976 known as the "Joint FAO/WHO Food and Animal Feed Contamination Monitoring Programme" to implement a recommendation of the UN Conference on the Human Environment. Many countries, particularly the United Kingdom and United States of America have carried out national surveys for the presence of pesticides and metals in food. The key feature of the Joint Programme by the FAO/WHO is the co-operation of established national contamination monitoring programmes. A

Joint FAO/WHO Programme in the monitoring of contaminants in food was started in this region in 1980 and the final report was presented at the terminal meeting in Nepal in 1984. The countries that participated in the programme were Nepal, Pakistan, India and Sri Lanka and the contaminants examined were pesticides, heavy metals and aflatoxins.

Chemicals are extensively used in agriculture and food. The chemicals used in agriculture are mainly fertilizers and pesticides. Most food additives are chemicals, which fall into the following classes or uses. They are used mainly as preservatives, colouring, antioxidants, emulsifiers, stabilizers, flavours and artificial sweetening agents. There are other uses such as anticaking agents, acidulants and buffering agents. The uses of these chemicals are stimulated by need to (1) maintain the physical and nutritional quality of food during shipment, storage and distribution and (2) make foods more attractive, more nutritive or otherwise more desirable. The long term effects of these chemicals may not be known and their use may create complex problems. There is bound to be concern about the safety of many of these chemicals, particularly about chronic toxicity, carcinogenicity, mutagenicity, and so on. Most countries exercise a control over the use of these additives. To exercise control, a knowledge of the properties of these chemicals, i.e. the safe limit, and the toxicity should be known. The Chemicals have to be evaluated. The Joint FAO/WHO Expert Committee on Food Additives (JECFA) is composed of experts who serve in their personal capacity. The Expert Committee evaluates food additives on the basis of all scientific data and where appropriate establishes 'acceptable daily intake' and the specification of identity or purity for the additive. The conclusions of the experts are published in reports and toxicological summaries by WHO as the "WHO Technical Report Series" and the "WHO Food Additives Series" respectively. Specifications of identity and purity for food additives are also published by FAO as "FAO Food and Nutrition Series". There are several specialized laboratories particularly in developed countries which carry out toxicity testing. The legislative aspect would be on the basis of available data.

The importance of knowing the properties of a chemical cannot be over emphasized. There is always new data available on continuing research. Let us take the case of DDT. This chemical was known as early as 1874. Although it was synthesized in 1874 its effectiveness as an insecticide was not observed until 1939 when it was also realized that the chemical could be synthesized from cheap raw materials. Because of limited supplies, most of the DDT produced in the world at that time was for protection of military areas and personnel, mainly against malaria, typhus and certain other vector borne diseases. It is said that soon after the liberation of Naples in January 1944 an epidemic of typhus broke out, but this was stopped in three weeks because during that time 1,300,000 civilians were dusted with DDT powder, thus killing their body lice, which carry the virus. The value of DDT was so recognized that in 1944, 4366 tonnes DDT were produced in the USA. On 31. August 1945 DDT was released for commercial sale and the production reached 15079 tonnes. The production reached 35771 tonnes in 1959 and from then on there was a decline in the production. The reason for this decline was due to ecological considerations. Scientists in Michigan in the late 1950's were seeking an explanation for the decline in the local population of certain bird species. They found sky blue robins eggs lying in a nest, outwardly quite normal - yet unhatched. It was found that residues of DDT sprayed on the trees concentrated in the bodies of earth worms eaten by the parent robins had doomed these eggs. Serious research work began in UK, USA and other countries on DDT and other chlorinated hydrocarbon pesticides. From bits of evidence in the late 1950's came the disturbing discovery that modern wonder chemicals such as DDT were not unmixed blessings; careless use could cause a major destruction of living species. Today many of the developed countries have restricted or banned the use of DDT except when it is needed for the protection of health. The lesson learned from this incident has made countries aware of the use of pesticides which have been evaluated.

Let us examine now how the necessary information about a chemical could be obtained by an individual, institution or an industry. There are so many chemicals in use and research data are available in several institutions, that to obtain the information there must be a central unit. There are data banks in more developed countries. But to obtain data may cost so much that a smaller institution may not be able to make use of the facility. The idea of a central unit arose out of a UN Conference in 1968. In 1968, Sweden, a neutral country with advanced industry and a long coast line on the dangerously polluted Baltic Sea, proposed a world conference of governments under the auspices of the UN to discuss problems of the human environment. This conference finally took place in Stockholm in June 1972. At this 1972 Stockholm Conference on the Human Environment, Recommendation 74e urged the Secretary General of the United Nations drawing on the resources of the entire UN system and with the active support of governments and appropriate scientific and other international bodies to "develop plans for an International Registry of Data on chemicals in the environment based on a collection of available scientific data, on the environmental behaviour of the most important man-made chemicals".

In 1974 the newly formed UN Environment Programme (UNEP) took on the task of establishing a chemicals register, to be based on a national information system and designed to ensure that hard data on the environmental and health effects of chemicals was made available.

In 1975 UNEP convened two meetings of government experts - first in January at Bilthoven in the Netherlands and the second in Nairobi in July. The purpose of these meetings was to establish guidelines for the operation of the International Register of Potentially Toxic Chemicals (IRPTC).

The UNEP Governing Council agreed that the register would have four main objectives:

1. To make the data on chemicals readily available to those who need it.

2. To locate and draw attention to the major gaps in the available information and encourage research to fill those gaps.

3. To identify the potential hazards of using chemicals and making people aware of them.

4. To assemble information on existing policies for control and regulations of hazardous chemicals at national, regional and global levels.

The Central Unit was set up in 1976 in Geneva and it was called the Programme Activity Centre of the IRPTC. It had two major objects (1) to collect, store and disseminate data on chemicals and (2) to operate a global network for information exchange. Participants outside the Central Unit are called Network partners. IRPTC's Network partners are National Correspondents of each country, National and International Institutions, Industries and External Contractors. Today almost every country has a National Correspondent. The National Correspondent for Sri Lanka is the Government Analyst. In addition the IRPTC proposed a National Register of Potentially Toxic Chemicals (NRPTC) and a few countries were selected for this purpose, Sri Lanka and Malaysia were the two countries in the region. The NRPTC was to collect available data on chemicals in the country and be able to carry out functions of the IRPTC in the country and the region. The NRPTC in this country is with the Central Environmental Authority (CEA).

Within the UNEP, the IRPTC works closely with INFOTERRA, Environmental Information Network, The Task Force on Research, Evaluation and Review, the Environmental Law Unit, The Task Force on Pollution and Human Health and the Regional Seas Programme.

Some of the International Bodies which are contributing partners to the IRPTC Network and with which the IRPTC works closely are the Environmental Chemical Data and Information Network (ECDIN) of the European Communities, the International Group of National Association of Manufacturers of Agro-Chemicals Products (GIFAP), the Chemical Group of the Organisation for Economic Co-operation and Development (OECD).

Several UN Bodies and Agencies such as WHO, FAO, ILO have programmes to which the work of the IRPTC has direct relevance.

The IRPTC prepares DATA Profiles for chemicals. The register includes Attributes which will serve to identify a chemical substance, to describe its physical and chemical characteristics, to estimate its availability to the environment, to present biological effects on man and the environment which have been important for hazard evaluation, to identify methods to be used in dealing with hazardous spills, to offer therapeutic measures for intoxication from the chemicals and to present control regulations for the chemicals. Actually the structure of the Data Profile is very important (See Page 11). Only when information is carefully organized can it be quickly retrieved. The IRPTC continue to monitor sources of new information with which to update and revise the files. Having said all these about the Central Information Unit from where DATA is to be obtained, how do the institutes or industries get the information? The National Correspondent is the person to whom the query has to be submitted. The National Correspondent will send it to the IRPTC who will comply with the request.

The National Correspondent who is one of the main network partners has an important function in the Query-Response System. He maintains an up-to-date list of interested research institutions, industries and government personnel likely to benefit. The National Correspondent collects necessary data for his file as that in the Query-Response system. He may in the first instance be able to give an answer. Most IRPTC information materials are distributed free which is a great asset to institutions in developing countries which cannot pay high fees to other data banks. Currently the IRPTC requests payment for the larger publications and this is generally a small sum. The number of queries received by IRPTC up to 1980 was less than 100 each year but after 1983 it has gone up to over 500 a year.

There are two other organizations - the International Agency for Research on Cancer (IARC) and the International Programme on Chemical Safety which contribute to the knowledge on chemicals. In 1971 (IARC) initiated a programme on the evaluation of the carcinogenic risk of chemicals to human beings with the object of producing monographs on individual chemicals. With the scientific collaboration and financial support of the US National Cancer Institute, IARC had in 1981 produced 25 volumes of monographs on about 532 chemicals.

Man is, therefore, surrounded by chemicals and he is gathering daily more and more knowledge about the properties of these chemicals. With this knowledge he can use these chemicals for his betterment, in a judicious manner.

IRPTC DATA PROFILE

The chain of action taken can be shown as follows:

REGISTER QUERY

↓

IDENTIFY CHEMICAL

↓

ACKNOWLEDGE RECEIPT OF QUERY
ASK FOR CLARIFICATION IF NECESSARY

↓

STUDY QUERY WITH RESPECT TO IRPTC FILES

↓

IS IRPTC DATA PROFILE AVAILABLE

↓

SEND DATA PROFILES TO USER; ASK IF ANSWER IS SATISFACTORY

CHECK OTHER SOURCES
1) IRPTC LIBRARY
2) BIBLIOGRAPHIC DATA BOX
3) NATIONAL CORRESPONDENT & OTHER RESPONDING NETWORK PARTNERS

↓

ASSEMBLE AND EVALUATE INFORMATION COMPLETED INCLUDING THAT RECEIVED FROM OUTSIDE SOURCES

↓

SEND INFORMATION TO USER;
ASK IF ANSWER IS SATISFACTORY

PESTICIDE USE IN THE FOOD PRODUCTION SECTOR IN SRI LANKA

by

Dr. W.A.T. Abeysekera

1. Pesticide use in Agriculture; Boon or Bane

The use of synthetic chemical substances, primarily in the form of pesticides, fertilizer and other growth regulatory substances appears to have become a virtually indispensable means of increasing crop productivity in most of our present day agricultural systems. Intensive use of these chemicals first began in the western economies and was later introduced into the agricultural production scenario in the developing countries. In Sri Lanka, the use of such chemicals for increased crop production was first associated with the plantation sector. However, the intensive use of chemicals as a means of expanding domestic food production began around 1960.

At present, the most intensive use of agro-chemical per unit of land is seen in isolated instances where potatoes and exotic vegetables and some cash crops are grown. However, within the food sector, the crop showing the largest use of agro-chemicals seems to be paddy. This is mainly because this crop is grown in an area of about 1.3 million acres by about 8 million farmers scattered in different parts of the country.

Most of the pesticides currently used are chemical substances highly effective even in trace proportions. Their efficacy depends primarily on the ability to disrupt or irreversibly change essential metabolic functions of plant and animal tissues. Because of this characteristic, any indiscriminate use of pesticides would lead to major unintended problems in human or animal populations as well as in the environment in which they live.

The use of pesticides in the food crop sector appears to have grown by leaps and bounds over the last 2 or 3 decades. This growth of pesticide use has been closely associated with productivity growth in the food sector. However, it is also

seen that increased pesticide use has led to unfavourable consequences both on the farmers who use such chemicals to boost production, and also the consumers of these food products at the end of the marketing chain. Similar negative consequences have also been identified with respect to environmental conditions.

A literature survey suggests that the term "pesticides" is rather loosely used to represent a wide range of agricultural chemicals used for controlling or eradicating pests and diseases. In a strict sense, however, "pesticides" are substances, either natural or synthetic, used to control pests. In order to be consistent with the general usage, the term is used in its broader sense. Depending on the specific use, pesticides could be further classified as weedicides, insecticides, fungicides, nematicides, acaricides and so on.

2. Objectives and Scope of the Paper

The primary intention of this paper is to examine the current status of pesticide use in the local food production sector, basically with a view to providing information that would highlight significant problems and trends.

3. Pesticides as an Aid to Increasing Domestic Food Output

Although, Sri Lanka has yet tô achieve its much cherished goal of food self-sufficiency, during the last two or three decades, the country has achieved a substantial progress in terms of increasing local production. Such developments are more evident in the case of paddy as a result of the heavy government patronage given to this crop. The paddy output has doubled over the last two decades and the production has maintained an annual acreage growth rate of a little over two percent. This output growth is a result of the expansion of area cultivated along with the increase in productivity (or yields per acre). An examination of the productivity growth in this sector shows that the yields have almost doubled in the past two decades. At present, the average national yield during Maha season is around 3.6 tons per hectare compared to the average of about 2.0 tons per hectare obtained in the mid sixties (Table 3.1).

Although not as impressive as that of paddy, many other seasonal food crops such as chillies, onions, potatoes, and up-country vegetables have shown substantial increases in their yields per acre during the past two or three decades. In almost all these instances, the present yields are significantly higher than actual farm yields a couple of decades ago.

A fundamental factor that has led to the observed productivity gains in the food crop sector, is the introduction of new improved crop varieties that are relatively more responsive to fertilizer and other inputs. This change has been initiated by plant-breeders whose endeavours in manipulating genetic mechanisms has led to the present day seed-fertilizer revolution. Responses to increased levels of Nitrogen is a key feature in almost all these new varieties produced during this period. As a concomittant to these high levels of Nitrogen and other plant nutrients, the crops also required higher levels of pesticidal applications. Thus, agro-chemicals have become a crucial, complementary input in modern agriculture.

Table 3.1

CHANGES IN AVERAGE YIELD OF PADDY (1960-1986)

Year	Maha Season (MT/HA)	Yala Season (MT/HA)	Annual (MT/HA)
1960/61	1.9	1.9	1.8
61/62	1.9	1.9	1.9
62/63	2.0	2.0	1.9
63/64	2.0	2.1	2.0
64/65	1.8	1.8	1.7
65/66	1.9	1.8	1.8
66/67	2.1	2.2	2.1
67/68	2.5	2.3	2.4
68/69	2.7	2.5	2.5
69/70	2.7	2.6	2.6
70/71	2.3	2.5	2.3
71/72	2.5	2.3	2.4
72/73	2.4	2.2	2.3
73/74	2.5	2.2	2.3
74/75	2.4	2.1	2.2
75/76	2.4	2.1	2.2
76/77	2.7	2.1	2.3
77/78	2.7	2.6	2.7
78/79	2.8	2.6	2.7
79/80	3.0	2.9	2.9
80/81	3.0	3.0	2.9
81/82	3.2	3.4	3.2
82/83	3.7	3.7	3.5
83/84	3.0	3.1	3.1
84/85	3.5	3.3	3.4
85/86	3.6	3.3	3.5

Source: **Department of Census and Statistics.**

4. Major types of Pesticides used in the Food Crop Production

Currently, a wide range of pesticides are being made available to farmers by pesticides manufacturing concerns. Depending on the functional activity, pesticides can be classified into a number of sub-categories. These categories involve those such as insecticides, weedicides, fungicides. A brief description of these categories follow:

Insecticides:

Perhaps one of the most commonly used pesticides in agricultural activities relates to insecticides. These insecticides are used to control an extremely diverse range of insect pests of food crops. Some of which are leaf-eating caterpillars, leaf-sucking aphids and thrips, leaf-miners, stem-borers, root-eating caterpillars and fruit-piercing insects. In the early part of the century, simple inorganic compounds such as arsenic and flouride compounds were used as insecticides. However, with the development of research on pesticides, a wide range of insecticides are now made available. Most of these are complex chemical compounds such as:

(a) Organochlorine compounds

(b) Organophosphorous compounds

(c) Carbamates

(d) Pyrethroids

Among these, some compounds such as Pyrethroids are extremely lethal, the nature of which is generally indicated in terms of LD 50 values. The LD 50 value of common pesticides is given in Table 4.1.

Fungicides:

Another common problem in most food crops relates to fungal attacks. Fungicides are commonly used in vegetable as well as in rice cultivation. Fungicides can be mainly categorized into inorganic chemical compounds and organic compounds. At present, most of the fungicides are organic compounds, and some of them are toxic to humans.

Weedicides:

These compounds are most commonly used in rice cultivation and on perennial food crops such as sugar-cane. The yields of modern crop varieties are extremely sensitive to competition by weeds and eradicating these has therefore, become a crucial task. There are two main types of weedicides; (a) total weedicides and (b) selective weedicides. Total weed-killers are capable of killing almost any plant (e.g. paraquat and arsenic compounds) and must therefore, be used only under special circumstances. Selective weed-killers such as MCPA and 2.3 D are on the other hand, particularly helpful in seasonal crop production.

In addition to the above three categories of pesticides, there are a number of other types of agricultural pesticides. Among them, are fumigants that control insects and micro-organisms in nurseries and grain stores. Chemicals belonging to this group are those such as Methyl Bromide. Acaricides form another group of pesticides that are used in crop production. These are used to control organisms such as mites and mostly involve sulphur and other compounds such as Bisdithiocarbamates. Nematicides are effective in controlling nematode pests, and the types of chemicals used for this purpose are methyl bromide, ethylene dibromide and chloropicrin. Another type of pesticides frequently used in agricultural production are the molluscicides. This group of chemicals is used for controlling snails and slugs.

Table 4.1

SOME AGRICULTURAL PESTICIDES AND THEIR RELATIVE TOXICITIES

Pesticide	Group	Common Use[1]	LD 50 value per kg. Body weight (in mg.)[2]
Insecticides			
Endrin	Organochlorine	–	1 – 7
Carburan	Carbamate	–	8 – 14
Parathion	Organophosphorous	All crops	2 – 10
Monocrotophos	Organophosphorous	All seasonal crops	20
Methomyle	Carbamate		2
Aldrin	Organochlorine	–	50
Fenetrothion	Organophosphorous	Paddy & field crops	?50 – 750
Fenthion	Organophosphorous	Field crops and vegetables	250
Chlordane	Organochlorine	Tea	400
Diazinon	Organophosphorous	Paddy	600
Permethrin	Pyrethroids	Onions	4000
Fungicides			
Cerasan	Inorganic	Seed Paddy	50 – 200
Mercury Oxide	Inorganic	Seed Potato and Seed Paddy	30 – 200
Zineb	Organic	Vegetables	5200
Captan	Organic	Vegetables	9000
Manvozeb	Organic	Vegetables	78,000

1. Some of these pesticides have already been banned in Sri Lanka.
2. Toxicity is usually determined on the basis of the effect on test animals and is measured in terms of LD 50 value. This is the dose which results in the death of 50% of the test animal population. It is expressed in mg. per kg. of body weight of the animal.

5. Natural Pesticides

Among plant species, there are many that can be used as effective pesticides. In fact, in the earlier stages of development of pesticides for commercial purposes, much reliance had been placed on these natural substances. Two common examples of which are Nicotine and Pyrethrum. Nicotine is extracted from the tobacco plant, and is effective for controlling thrips and aphids. It is highly volatile and hence, could even be used as a fumigant. Pyrethrum is a substance extracted from the flower of Chrysanthemum cinararifolium. Pyrethrum has been widely used as an insecticide in agriculture, prior to the introduction of modern chemicals.

Unfortunately, with the advent of modern chemicals, the use of natural pesticides has gradually disappeared. However, research in Sri Lanka has shown that there is a wide range of plant sources that can be effectively utilized for extracting insecticides. One such potential source is the Azadirecta indica (Kohomba). The leaves and fruits of this plant have been shown to contain a substance Azadiretin which has important insecticidal properties.

6. Changes in Production Technology in the Domestic Food Crop Sector and Pesticide Use

A significant trend that is discernible in Sri Lanka's domestic food crop sector is the increasing dependence on pesticide use during the past two or three decades. In the early half of the present century, the use of pesticides was limited mainly to the plantation crop sector.

The use of pesticides in the domestic food crop sector on a substantial scale began only in the 1960s. The change is primarily the result of the increasing adoption of improved rice varieties by farmers during this period. At present, almost 90% of the total paddy acreage is under high yielding varieties. Similarly, the bulk of the crops grown today represent some form of improved germplasm. (Table 6.1).

Table 6.1

DISTRIBUTION OF PADDY VARIETIES IN SRI LANKA, CLASSIFIED BY AGE GROUP AND SEASON

		Extent cultivated as a % of total		
Age Group	Variety	Yala (%) 1985	Maha (%) 85/86	Annual (%)
a) New Improved Varieties				
3 Months	BG 34 – 8	22.4	14.7	18.6
	BG 276 – 5	12.6	9.0	10.8
	BG 272 – 60	3.0	1.1	2.1
3½ Months	BG 94 – 1	28.7	23.3	26.0
	BG 34 – 6	7.2	8.7	8.0
	BG 94 – 2	0.2	0.4	0.3
4–4½ Months	BG 400 – 1	9.6	17.0	13.3
	BG 379 – 2	5.1	5.3	5.2
	BG 11 – 11	1.4	6.9	4.2
	BG 38 – 0	1.7	1.1	1.4
	BG 90 – 2	0.8	0.4	0.6
b) Old Improved Varieties				
	H_4	2.1	6.3	4.2
c) Others (mainly traditional varieties)	–	5.2	5.8	5.3
	ALL :	100.0	100.0	100.00

Source: Jayawardena, S.D.G. . . . . (et al.)
"A Total Concept of Rice Research and Development through Gene Base and Varietal Spread Pattern Analysis."
(Unpublished mimeo, Department of Agriculture, 1987)

From the 1960s onwards, remarkable changes have taken place in Sri Lanka's paddy sector and most of these changes have favoured the increased use of pesticides. Prior to the introduction of high yielding varieties (HYVs), the entire extent of paddy grown in Sri Lanka was represented by about 150 different indigenous varieties. These varieties were low yielding, i.e. not more than 20-25 bushels per acre at the most, but generally showed a high degree of resistance to pest and diseases. The first hybrid variety, H_4, (categorized as belonging to the old high yielding varieties or OHYVs) was released for cultivation in 1959.

As a consequence of its relative high yielding ability, coupled with a reasonably high adaptability to a wide range of environmental conditions, the adoption of H_4 variety was rather quick. Within a period of about 5 years or so, it occupied almost half the extent cultivated under paddy. H_4, unlike the earlier indigenous varieties responded to fertilizer as well as pesticides.

However, the most important breakthrough in rice production, came in the mid 1960s with the introduction of new high yielding dwarf varieties of rice as a part of the "Green Revolution". The first two varieties to be introduced represented the IR 8 (bred in Philippines) and TN 1 (from Taiwan). Both these varieties were high yielding and farmers obtained yields as high as 100 bushels per acre, which was almost 2-3 times their normal yields. Unfortunately, these two varieties required extremely heavy doses of agro-chemicals, both in terms of pesticides and fertilizers.

Subsequently, in the early 1970s, Sri Lanka released its first dwarf variety of rice, BG 11-11, with a high yield potential. Since then, remarkable achievements have been made in rice production technology, and underlying this "Seed-Fertilizer - Pesticide Revolution" are the gains made with respect to yields (Table 6.2). With this growth in yields, as a complementary input, an almost parallel growth has taken place in the case of pesticide use.

Table 6.2

GAINS IN YIELD POTENTIAL (RECORDED HIGHEST YIELDS) IN SRI LANKA'S PADDY SECTOR - 1950 - 1980 (TONS/HECTARE)

	1950s	1960s	1970s	1980s
6 months	2.57	6.18	6.18	7.73
4 1/2 months	2.57	5.15	10.31	10.31
3 1/2 months	-	4.12	10.31	10.31
3 months	-	3.09	-	7.22
2 1/2 months	-	-	-	3.86

Source: Jayawardena, S.D.G....(et al.) "A Total Concept of Rice Research and Development through Gene Base and Varietal Spread Pattern Analysis." (Unpublished mimeo, Department of Agriculture, 1987)

As seen from Table 6.2, Sri Lanka's productivity in the paddy sector has made substantial advances between the 1950s and 1970s. During this period the maximum yields that were obtainable had reached almost 10 tons per hectare. This change has been basically possible due to application of agro-chemicals.

7. Growth Pattern of Pesticide Use in the Food Crop Sector

As mentioned earlier, the intensive use of chemical substances in the domestic food crop sector began as a complementary input to the high yielding rice varieties in the mid 1960s. Farm level data suggest that since then, the use of pesticides has shown considerable increases. However, as a result of foreign exchange difficulties the country faced around mid 1970s, relatively low levels of pesticides have been imported. During this period, most rice growing areas of the country showed an acute shortage in the availability of chemicals and this situation led to a substantial reduction of the per acre use of chemicals.

The rate of use of agricultural pesticide at the national level in late 1970, however, showed a significant increase. This is basically due to the result of the liberalized economic policies of the government pursued since 1977. Unlike in the previous periods, at present, the farmers have easy access to a wide range of agro-chemicals to choose from depending on their needs. In addition to liberalized import policies aggressive sales promotional campaigns, have also made the pesticide trade one of the most competitive.

As a result of this growth in pesticide use, a substantial amount of foreign exchange is now spent on importing these substances. In fact, within the period 1970-79, the expenditure on imports has been estimated to have grown twenty times. (Economic Review, Jan. 1983). It was also estimated that in 1985, there were about 110 pesticides in about 200 formulations.

The popular adoption of pesticides bears significant consequences on the farm level costs and returns. The influence of the widespread use of chemicals on paddy agriculture can be seen from Table 7.1.

This shows that the cost of puchasing weedicides and pesticides taken together, is in the range of Rs. 400 per acre in the case of major paddy growing areas such as Ampara and Batticaloa. In such situations, pesticides and weedicides account for about 10% of the total cost of purchased inputs. However, if labour is also taken into account, the practice of pesticide application accounts for little over 10% of a farmer's cash costs.

Table 7.1

COST OF CULTIVATION OF PADDY IN THREE SELECTED DISTRICTS (MAHA – 1985/86)

	Ampara		Anuradhapura		Kandy	
	Irrigated (Rs/Ac)	Rainfed (Rs/Ac)	Irrigated (Rs/Ac)	Rainfed (Rs/Ac)	Irrigated (Rs/Ac)	Rainfed (Rs/Ac)
Total cash costs (Rs/Ac)	3144	3043	2605	1953	2099	2032
%	(100)	(100)	(100)	(100)	(100)	(100)
Cost of fertilizer (Rs/Ac)	516	447	447	398	536	533
%	(16.4)	(14.6)	(17.1)	(20.3)	(25.5)	(26.2)
Weedicides (Rs/Ac)	206	168	92	–	–	–
%	(6.5)	(5.5)	(3.5)	–	–	–
Pesticides (Rs/Ac)	195	241	106	63	90	101
%	(6.2)	(7.9)	(4.0)	(2.2)	(4.2)	(4.9)

Source **: Agricultural Economics Study No. 41, Department of Agriculture.**

Among cash crops such as potatoes, onions and chillies, also the cost of pesticide use is significant. The highest cost per acre is seen in potato with about Rs. 3268 per acre (Table 7.2).

Table 7.2

COST OF CULTIVATION PER ACRE OF POTATOES, ONIONS AND CHILLIES (MAHA 1985/1986)

ACTIVITY	Potatoes (Nuwara Eliya – irrigated)		Onions Puttalam – irrigated)		Chillies (Anuradhapura – irrigated)	
	Amount (Rs/Ac)	%	Amount (Rs/Ac)	%	Amount (Rs/Ac)	%
1. Land preparation (including planting)	19,285	54.0	13,195	45.9	1,554	30.7
2. Fertilizer application	8,813	24.7	4,695	16.3	778	15.4
3. Pest and Disease control						
i. Material	1,908		462		306	
ii. Labour	1,297		101		80	
Sub-Total –	3,205	9.0	563	2.0	386	7.6
4. After care purposes	3,268	9.2	5,969	20.7	1,405	27.7
5. Harvesting and transport produce to stores (inclusive of all the post harvest operations).	1,115	3.1	4,358	15.1	944	18.6
TOTAL –	35,686	100.0	28,780	100.0	5,067	100.0

Source **: Agricultural Economics Study No. 41, Department of Agriculture, Peradeniya.**

8. Farmer behaviour underlying pesticide Use

With a view to identifying the behaviour of farmers in respect of chemicals, a detailed survey was undertaken in Mahagastota in the Nuwara Eliya District in 1986. The sample covered about 40 farmers who were involved in vegetable cultivation. The survey surfaced a number of interesting insights which could be summarized as follows:

The information showed that inspite of noticeable instances of pest attacks and diseases, 40% of the farmers have continued to apply pesticides to their fields. These applications have been made solely as protective applications rather than as curative measures.

Range of pesticides used: The investigations showed that farmers used an extremely wide range of insecticides and pesticides for raising their crops. The types of chemicals used in this instance are as follows:

Table 8.1

PESTICIDES USED BY VEGETABLE FARMERS IN MAHAGASTOTA, NUWARA ELIYA.

Trade Name	% of Farmers
Insecticides	
Tamaron	48
Monitor	28
Ambush	20
Cidial	10
Others	6
Fungicides	
Polyram	38
Dacanil	13
Antracol	7
Dithane	8
Redomyl	5
Sulphur	5
Vandozeb	3

Source: Farm Survey, 1986/87 Maha Season

Frequency of applications: Weather conditions, specifically rain appears to be the major determinant of the time of application of pesticides. Wet weather generally favours the multiplication of pests and diseases and under such conditions chemicals are applied once in 3 or 4 days. In general, the frequency of application is greater during the early phases of vegetable crops.

For safety reasons, a minimum of a 7 day interval between applications is usually recommended. However, farmers often apply chemicals at much more frequent intervals. The frequency of applications are important from a cost point of view (Table 8.2).

Table 8.2

AVERAGE TIME INTERVAL BETWEEN SUCCESSIVE APPLICATIONS OF PESTICIDES BY VEGETABLE FARMERS IN MAHAGASTOTA, NUWARA ELIYA.

Type of chemical	% of farmers applying with			
	3-6 day interval	6-7 day interval	8-14 day interval	2-3 week interval
Insecticides	12	48	15	25
Pesticides	28	52	10	8

Source: Farm Survey, 1986/87 Maha Season

Application dosages: In general, farmers tend to use doses higher than what is usually recommended. The majority of farmers seems to be under the impression that the recommended dosage is inadequate for effective pest control. A higher concentration that will result in instantaneous eradication of pests seems to be the preference.

It is also possible that with the constant use of chemicals in this area, insects and other pathogens would have developed some level of resistance to the pesticides used. Furthermore, it was also observed that farmers do not adhere to accurate measurements to achieve the recommended dilutions. Often, they use improvised measures such as match boxes or the lids of the pesticides bottles.

Whatever the reason given, the concentration of the pesticide solutions applied is often significantly higher than recommended. In some cases, farmers used about four times the recommendation (Table 8.3).

Table 8.3

CONCENTRATION OF THE PESTICIDES PREPARATION USED FOR SPRAYING VEGETABLE CROPS, MAHAGASTOTA, NUWARA ELIYA

Type of Pesticides	% of farmers using			
	Recommended or less	Twice recommended	Thrice recommended	Four times the recommendation
Tamaron	35	43	14	7
Monitor	23	38	2	-
Polyram	-	46	46	26
Vandozeb	-	66	11	-

Source: Farm Survey, 1986/87 Maha Season

Method of application: The most common method of application of pesticides is in the form of solution. Often, farmers use a mixture of two or more chemicals with a view to saving on labour. Such mixing was more common in the case of fungicides. Furthermore, it was also observed that the use of liquid fertilizer is on the increase. Instances of farmers mixing the pesticides with the liquid fertilizer were also seen. It is most likely that the use of such mixtures would lead to unexpected interactions in the activity or the toxicity of the chemicals used.

Adherence to safety measures: In general, it was observed that most of the farmers in the area used no special protective clothing or any other measures when applying chemicals. The impression gained from the field interviews was that many of them have developed a less rigorous attitude towards the use of proper safety measures. Perhaps, the routine handling of chemicals may have imparted to them a familiarity with these chemicals which in turn could lead to such an attitude. Neither the cleaning of hands, body and

clothes after spraying chemicals nor the cleaning of equipment seem to be strictly adhered to. In some instances, it also appeared that they were even in the habit of smoking or chewing betel while handling the sprayer. It was found that the sprayers at times are washed in nearby streams. The investigation also showed that the empty cans and bottles of pesticides are carelessly disposed of. Most of the farmers seem to be in the habit of disposing them rather indiscriminately and a few others seem to have sold the empty containers.

Time of application of pesticides prior to harvesting: The general recommendation regarding this is that the application of chemicals should be stopped at least two weeks before harvesting. This is because, some chemicals have relatively long periods of residual effects. However, interviews conducted in this regard again suggested an extremely high degree of non-adherence to safety rules. The survey indicated that about 50% of the farmers have harvested crops within 2 weeks of application of chemicals. Nearly one-tenth of the farmers interviewed harvested their crop within a period of one week. Farmers in general are not seriously concerned with the health hazard that may result from eating vegetables with high residual concentrations of agro-chemicals. However, this problem does not appear to be significant in the case of potatoes (Table 8.4).

Table 8.4

TIME INTERVAL BETWEEN CHEMICAL APPLICATION AND HARVESTING, VEGETABLE FARMERS AT MAHAGASTOTA IN NUWARA ELIYA

C R O P	Time interval before harvest			
	Less than 1 week	1 - 2 weeks	2 - 3 weeks	4 weeks or more
Potatoes	5	15	30	50
Vegetables	9	50	32	9

Source: Farm Survey, 1986/87 Maha Season

Procurement and storage of chemicals: Data regarding the procurement of chemicals indicate that the majority (72%) of farmers in the study area purchased their agro-chemicals at the beginning of the cultivation season. This situation seemed to arise from farmers' expectations regarding price increases and also of avoiding any shortages. All farmers had purchased their pesticides from private traders in the area. Once taken home, farmers do not seem to be paying adequate attention to the storage of these items. Less than 5% of the sample farmers seem to have a separate, special location for storing these harmful substances.

Extension advice regarding pesticide use: The survey revealed that the most important source of necessary information for farmers regarding pesticide use was the private trader (Table 8.5). The next most important source of receiving information appeared to be other experienced farmers. The survey also revealed that only a small proportion (12%) of the sample farmers sought advice from the field level agricultural extension worker in the area.

Table 8.5

SOURCE OF INFORMATION REGARDING THE USE OF PESTICIDES BY VEGETABLE FARMERS, MAHAGASTOTA NUWARA ELIYA

Source of information	% of farmers
Pesticide trader	51
Other farmers	30
KVS	12
Own experience	7
All:	100

Source: Farm Survey 1986/87 Maha Season.

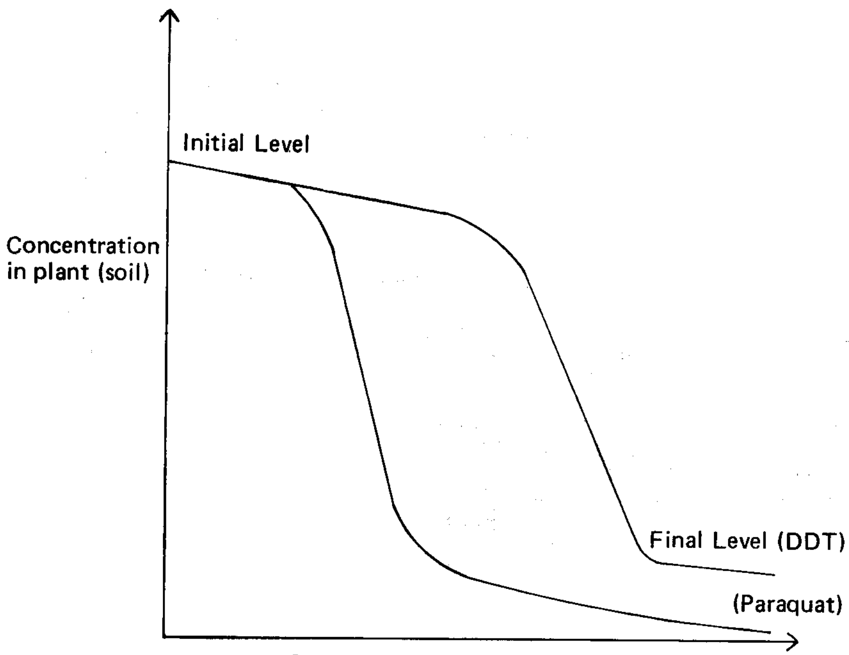
The relatively minor role played by the Field Level Agricultural Extension Worker (KVS) as a source of information regarding pesticide use, requires closer attention. The trader acting as a main source of information on the use of chemicals is rather unsatisfactory from the farmers' standpoint.

Fate of pesticides applied in the field: As already seen in the case of most annual food crops, quantities of pesticides are periodically applied on the plant or on the soil surface. Occasionally, as in the case of paddy, pesticides are added to the water to be absorbed by the plant for a systemic action. The most common forms of pesticides applied to the plants are liquid sprays, powder or granular forms.

Some of the pesticides that are being currently used are easily decomposable and their toxic effect would therefore disappear within a relatively shorter period. An example of this type of chemical is Paraquat. Some pesticides such as DDT on the other hand, are most resistant to natural decomposition. Often these compounds tend to persist for long periods (Figure 1). The rate of disappearance of the toxicity of a pesticide applied on the soil or on the plant is dependent on a wide range of factors including humidity, temperature, PH, and so on.

Figure 1

RELATIONSHIP BETWEEN PESTICIDE CONCENTRATION AND DAYS AFTER APPLICATION



A pesticide once applied on a plant or soil could undergo various transformations and cyclical processes (Figure 2). Part of this may be washed off as surface run-off due to rain. Another part may volatilize depending on the nature of the substance. A further portion is likely to be subjected to natural decomposition by sunlight (photo-decomposition). The crop would also absorb a part of the pesticides applied through the soil solution or even through its vegetative parts. It is also likely that pesticides may also enter the soil through the movement of soil water. It then becomes dissolved in the soil solution. Part of the pesticides entering the soil solution would be absorbed by soil Colloids and other particles which could retain the chemical substance for longer periods of time. While within the soil, some of the pesticides would decompose due to chemical, bacterial and other biological processes. It is most likely, that some of the pesticides would leach downwards and get mixed with the ground water or it may even move horizontally thereby contaminating other water bodies.

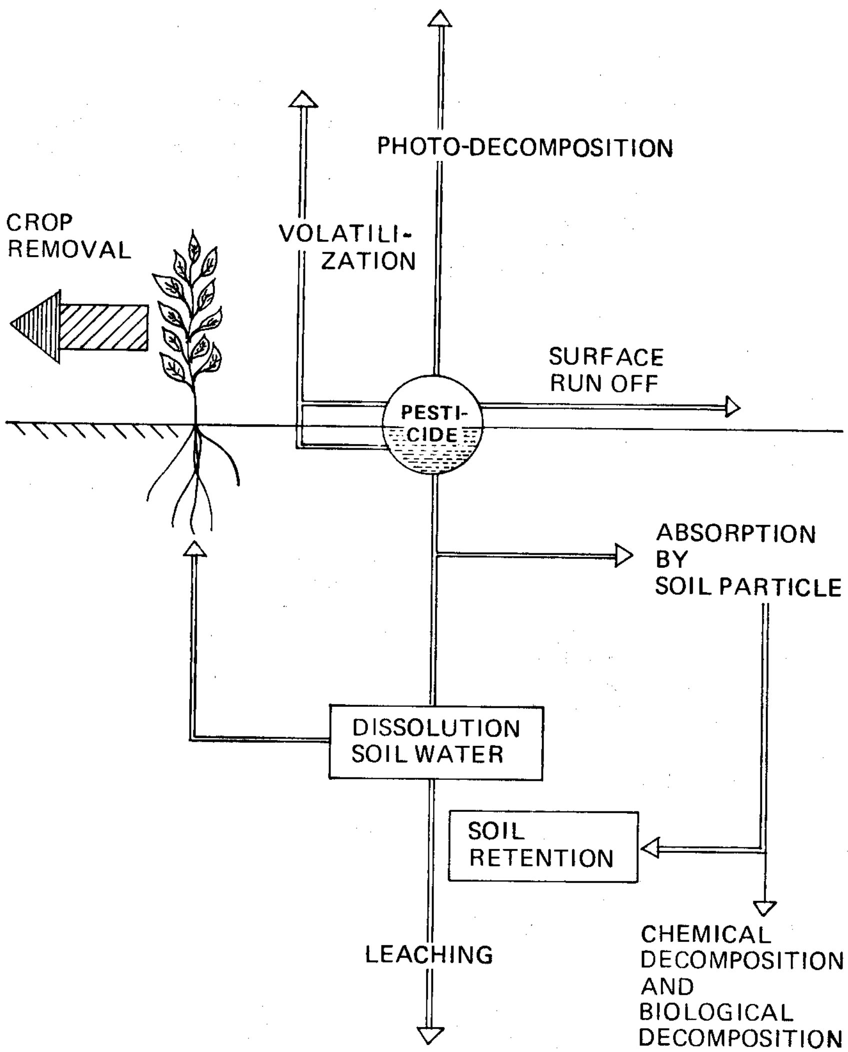
Factors favouring increased pesticide use: A consideration of the evidence relating to the past experience in pesticide use, suggests that the country's food production technology is heavily biased towards intensive use of such chemicals. The bulk of the problem of this growing dependency is due to the inherent nature of the High Yielding Varieties (HYVs).

Nature of HYVs itself: The HYVs in general are heavy consumers of nitrogen and other plant nutrients. Increased nitrogen application for instance, rapidly increases the plant's susceptibility to insect pests and diseases. Nitrogen in particular, stimulates the growth of meristematic tissue leading to luscious vegetative growth. Leaves in general become more succulent or fleshy. The cell sap becomes more concentrated with nitrogenous material. All these developments provide an extremely favourable medium for insects and other disease causing pathogens to feed or grow on. The inevitable result is that the host plants become more attractive to the pests thus necessitating increased dosages of pesticides.

Plant type: In the case of rice, however, a special feature inherent in the New High Yielding Varieties (NHYVs) is that it favours increased weed growth as against their traditional

Figure 2

PESTICIDE ACTIVITY IN THE ENVIRONMENT



counterparts. The plant type of these NHYVs, represents plants with shorter height, with broad and semi-erect leaves. This situation therefore allows more sunlight to penetrate into the soil which favours increased weed growth. Once weeds emerge, they tend to smother the rice plant quickly. Because of these reasons, weedicide application has become an indispensable activity in today's paddy culture.

<u>Escalating rural wage rates:</u> In the past decade, wages have been fast rising, a factor that has been favouring the substitution of chemicals for manual weed control in paddy.

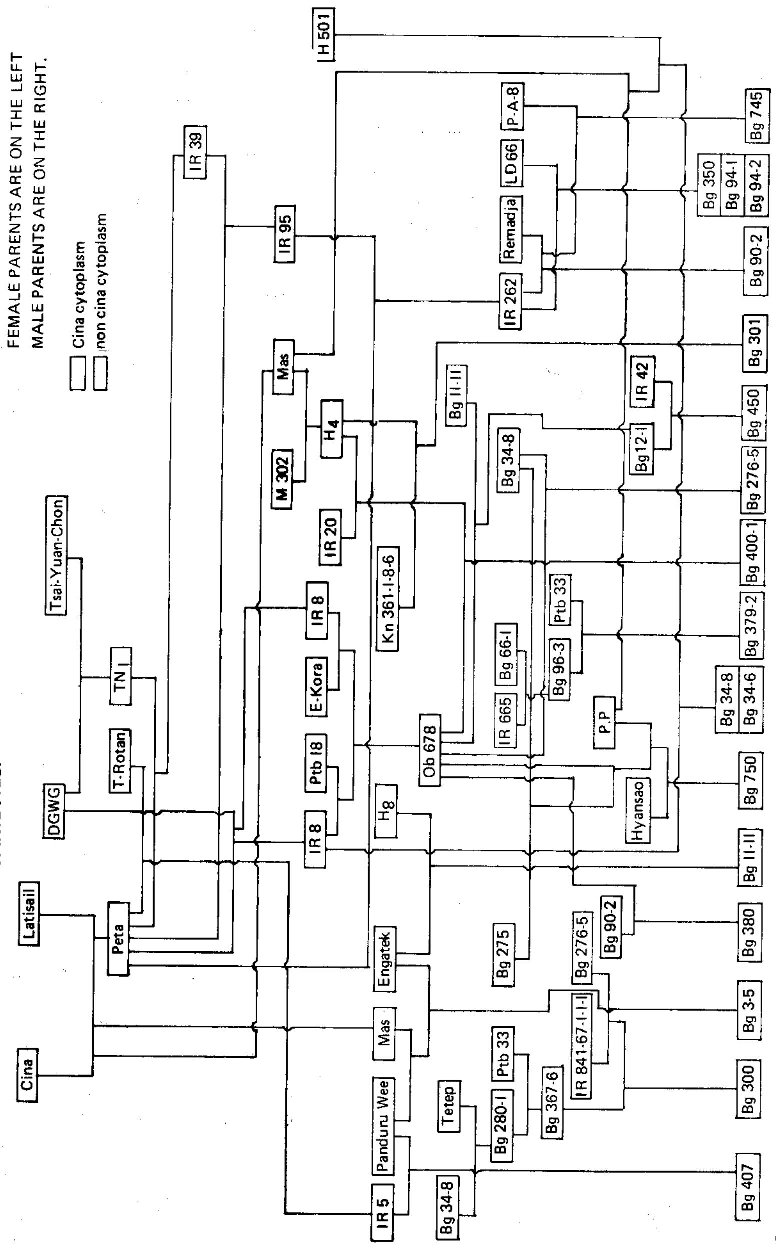
<u>Narrowing of the Gene Base:</u> With regard to the New High Yielding Varieties (NHYVs), at least in the case of rice, there seems to have occurred a significant narrowing of the gene base. At present, in rice, the gene base is represented by about 5-10 predominantly cultivated varieties (Figure 3). This phenomenon has led to a significantly high degree of cytoplasmic uniformity which in turn is most likely to have contributed to a significant reduction of the plant's capability to withstand pests and diseases.

As a consequence of this transformation, the resistance to major pests and diseases such as Brown Plant Hopper (BPH), Gall Midge, Blast and Bacterial Leaf Blight (BLB) is totally dependent on a limited source of genes.

<u>Resistance build-up by pest populations:</u> This is another plausible reason,. explaining the increased tendency to use more pesticides in today's agriculture. Continuous use of pesticides enable the pests to gradually develop resistance to such chemical substances primarily through the process of natural selection. In fact, there is a lot of evidence from the field that such a phenomenon is occurring in most of our food crops such as in the case of paddy bug (Leptocorrhiza Varicornis).

<u>Reduction of decimation of predators:</u> In nature, there are numerous predatory organisms that usually provide a delicate balance between the parasites and the host populations. This therefore, provides a check on the multiplication of the pest population beyond a certain threshold. However, with the increasing application of insecticides, this natural balance could be seriously disturbed. The frequent application of

Figure 3
GENETIC ANCESTRY OF BATALAGODA VARIETIES.



Source : "A Total Concept in Rice Research and Development through Gene Base and Varietal Spread Pattern Analysis", S. D. G. Jayawardena, R. Peiris and S. C. J. Dissanayake, Dept. of Agriculture, 1987.

protective sprays provides an ideal condition for such a situation. In fact, the existence of sudden outbursts of pest attacks such as that of Brown Plant Hopper or rodents on paddy is likely to have arisen from such situations.

Cultural practices adopted for intensifying production: Although attempts to increase cropping intensities of land is desired in terms of output growth, it is most likely to have led to problematic situations with respect to natural breeding of insects, pests and pathogen populations. For instance, with the provision of irrigation water and other inputs, today, unlike in the past, farming is undertaken on an intensive scale over large extents of land. Staggering of cultivation is also a common practice. In many instances, fallowing is not practiced. All such situations could therefore lead to increased pest populations.

Promotional campaigns and liberal availability of pesticides: The aggressive promotional drives undertaken through mass media and attractive advertisements and labels would perhaps have contributed significantly to the increased use of pesticides as seen today. Under trade liberalization policies witnessed during the past ten years, the availability of pesticides has not become a constraint to those using these substances. In fact, in many of the rural, agricultural areas, it is clearly seen that the trading activities relating to agro-chemicals have become significant.

Inadequate knowledge of the farmers: Personal interviews conducted in many areas, particularly those cultivating vegetables in the upcountry areas suggest that many farmers often use pesticides without adequate knowledge of their harmful effects to others, and to the environment in general. Often, information regarding the need for pesticides, types to be used, frequency of application and their concentration, are generally obtained either from dealers or from neighbouring farmers. This situation therefore could lead to less than satisfactory situations and is most likely to result in misuse of these dangerous substances. This problem of inadequate knowledge of the farmers concerning pesticide use has been recognised over the past few years. As a result, a number of farmer education programmes have been undertaken by the Department of Agriculture. Another significant step in this direction is the introduction of an integrated pest management programme by the Department to cover most of the agricultural districts.

AGRO-CHEMICALS IN THE PLANTATION SECTOR

by

U.E.R. Gangoda

THE USE OF WEEDICIDES IN TEA:

Manual weeding was done in Tea Plantations until recently. As weeding has to be done at frequent intervals to keep the Plantations weed-free, the cost of weeding increased with increase in cost of labour. Manual weeding also caused loss of valuable top soil by soil erosion. Because of these factors, alternate methods of weed control had to be found. Testing of Herbicides for the control of weeds in tea started in the late 1940s with 2,4-D based Weedicides, (2,4-dichloro-phenoxy acetic acid, belongs to phenoxy compounds and are translocated in the plant, (hormone type). Later, MCPA (2-methyl-4-chloro-phenoxy acetic acid), 2,4,5-T (2,4,5-trichlorophenoxy acetic acid), Dalapon, Sodium Chlorate - $NaClO_3$ (inorganic compound) with pre- and post-emergence or contact action on annual and perennial weeds, were introduced. Pentachlorophenol and Simazine had been tested for the control of grasses such as couch and illuk. In the late 1950s and early 1960s, a 2% solution of Dalapon and 1% Teepol was recommended on an experimental basis for the control of couch and illuk in non-tea areas at 45-67.5 kg per hectare diluted in 556-665 litres of water. In the early 1960s the following Weedicides were recommended for the control of weeds in the tea by the agro-chemical companies:

1. **Simazine 50 WP.**
   Belongs to Triazine group of compounds. Pre-emergence weedicide recommended for the control of broad leaf and grass weeds in mature and young tea.

2. **Dalapon.**
   Belongs to aliphatic compounds.

3. **Diuron WP 80%.**
   Belongs to Urea group of compounds.

4. **Paraquat.**
   Belongs to Quartary Ammonium Compounds.

In the 1960s many tea plantations started using Weedicides for the control of weeds and at present Weedicides are the most widely used pesticides when compared with insecticides and fungicides.

2. Pesticides also could be classified according to the effect on the pest:

<u>Classification by the Effect on the Pest:</u>

Attractant	- Lures pests to treated location, e.g. Sex Attractants.
Repellent	- Drives pests away from treated object without killing.
Anti-Feedant	- Inhibits feeding while the insects remain on the treated plant and starve to death.
Chemosterilant	- Destroys a pest's ability to reproduce.
Pheromones	- Releases or inhibits certain behavioural activities of insects.
Plant Growth Regulator	- Stops, speeds up or otherwise changes normal plant growth processes.
Defoliant	- Removes unwanted plant growth without killing the whole plant immediately.
Desiccant	- Dries up plant leaves, stems and insects.

3. According to the nature of the chemical:

<u>Classification by Chemical Nature:</u>

Most common pesticides can be classified into two main chemical groups - The Inorganic and Organic Compounds:

(a) Inorganic Compounds:
Cuprous Oxide,
Lime Sulphur, (Bordeaux Mixture).
Mercuric Oxide.

(b) Organic Compounds:
(i) Organophosphorous Compounds:
e.g. Fenthion,
Methamidophos,
Phoxim,
Edifenphos.

(ii) Carbamate Compounds:
e.g. BPMC,
Propoxur,
Carbofuran.

(iii) Organochlorine Compounds:
e.g. Chlordane,
DDT,
Endosulfan.

(iv) Synthetic Pyrethroids:
e.g. Cyfluthrin.

Acaricides, Fungicides, Herbicides, Insecticides and Nematicides, mainly used in Plantation Crops such as tea, rubber and coconut, will also be discussed.

AGRO-CHEMICALS IN THE PLANTATION SECTOR

Chemicals used in Agriculture could be classified into two major groups:

1. Fertilizers.
2. Pesticides.

It is important to know what is a Pest and what is a Pesticide.

Pest:
Any organism which injures man, his property or his environment or which annoys him. Such organisms include principally certain insects, nematodes, fungi, weeds, birds, rodents or any other terrestrial or aquatic plant or animal life or virus, bacteria or organisms.

Pesticide:
Any substance or mixture of substances intended for preventing, destroying or repelling any insects, rodents, nematodes, fungi or weeds, or any other form of life declared to be a pest and any substance or mixture or substances intended for use as a plant regulator, defoliant or desiccant.

Pesticides may be classified into various groups by a number of methods:

1. Classification according to the group of pests they will control:

Acaricide	- Mites, Ticks and Spiders
Algaecide	- Algae
Avicide	- Birds
Bactericide	- Bacteria
Fungicide	- Fungi
Herbicide	- Weeds
Insecticide	- Insects and other related pests such as Ticks and Spiders
Miticide	- Mites
Molluscicide	- Molluscs such as Slugs and Snails
Nematicide	- Nematodes
Rodenticide	- Rodents

The Tea Research Institute first recommended Weedicides in the early 1970s. Paraquat, Diuron, Simazine, Dalapon, 2,4-D and MCPA, were first recommended. In 1980, Glyphosate was recommended for the control of Rhizomatous grasses and in 1985 Oxyfluorfen for general weed control.

Recommended Weedicides for the control of weeds in tea are:

1. Paraquat:
   Paraquat is a post-emergence contact weedicide. It is absorbed by the foliage and acts quickly. Paraquat is recommended at a rate of 0.74 - 1.1 L of product diluted in 550 litres of water per hectare. Controls standing weeds and it is more effective on young weeds than on mature weeds. Should not spray onto tea leaves or young stem. Mist Blower is not recommended for spraying.

2. Diuron WP 80%:
   Diuron is a pre- and early post-emergence residual weedicide and is recommended at a rate of 840 - 1120 g in 550 - 680 litres of water per hectare using a Knapsack Sprayer. Diuron should be applied to relatively clean land and soil should be moist for effective results.

3. Simazine:
   Simazine is a residual pre-emergence herbicide. Recommended at 2.5 - 3.75 kg in 555 litres of water per hectare.

4. 2,4-D/MCPA:
   Belongs to Phenoxy group of compounds and its activity is post-emergent with translocate hormone type. It is recommended for the control of broad leaf weeds which are not controlled by Paraquat, such as Commelina spp, Erigeron suatrensis, Boreria spp, at 1 - 2 kg of product in 562 - 674 litres of water per hectare.

5. Dalapon:
   A translocated herbicide and is recommended for the control of grass weeds not controlled by Grammaxone at a rate of 6.75 kg in 560 - 675 litres of water per hectare.

6. Glyphosate:
   A translocated herbicide and belongs to Phosphorous group of compounds. It is recommended for the control of Rhizomatous grass weeds such as couch grass (Pahnicum repens), at the rate of 1.0 L in 50 litres of water using 600 litres of spray mixture per hectare.

7. Oxyfluorfen 24% EC:
   Belongs to Diphenylether compounds and a pre-emergent herbicide. Recommended for the control of weeds in tea either alone or with Paraquat. Rate recommended is 1.2 litres of product per hectare. It controls broad leaf weeds and grasses. Soil should be moist for effective results. Paraquat is the most widely used herbicide followed by Diuron WP 80%.

Product:	Dosage/per Hectare
*Diuron WP 80%	850 g - 1 kg
*Oxyfluorfen 24% EC	1.235 L
Simazine 50% WP	2.5 - 3.7 kg
*Glyphosate EC 36%	12 L
*Paraquat	750 - 1100 ml
Dalapon 80% WP	6.75 kg
2,4-D and MCPA	450 - 900 g a.,i.

555 L of water is used per Hectare.

Average Cost per Hectare per Application:

1) Weedicides:

Product.	Cost per Hectare.
Paraquat	Rs. 65/- to Rs. 97/-
Diuron WP 80%	Rs. 153/- to Rs. 180/-
Glyphosate 36%	Rs. 10,425/-
Oxyfluorfen	Rs. 740/-
Dalapon 80% WP	Rs. 760/-
2,4-D 80% WP	Rs. 45/- to Rs. 90/-

* (Commonly used Weedicides)

THE USE OF FUNGICIDES IN TEA

Prior to 1946 the use of Fungicides in tea was very little. The commonly used Fungicides were Bordeaux Mixture, (Copper Sulphate and Lime), and Lime Sulphur, (a complex of Sulphur and Lime). When Blister Blight, (Exobasidium vexans), first appeared in 1946 these two Fungicides were tested. Bordeaux Mixture which gave reasonable control was replaced by Copper Oxychloride and Cuprous Oxide.

Copper was used as a Liquid Spray as well as a Dust. Dust, which contained 4-6% Copper was used at 5-8 lb./acre, once in 5 days. Copper, in the form of Wettable Powder in which Copper content was 50%, was used at 4-6 oz./acre once in 7-9 days as a Liquid Spray. Dusting is not practised now as its application had many practical difficulties.

Nickel Compounds were used in the late 1960s which had both a protective and curative effect. However, the use of Nickel Compounds was banned in the late 1970s.

Santar is the only Mercury Compound used in tea for the protection of pruning cuts as a fungicidal paint.

Recommended Fungicides in Tea as follows: -

1. Blister blight, (Exobasidium vexans):
   Only Copper based Fungicides were used widely for the control of Blister blight in Tea until recently. Copper Oxide 50% WP and Copper Oxychloride WP 50% are being used. In the up-country areas Copper Fungicides may be sprayed at 20 - 25 rounds per year.

   (a) Nurseries:
   120 g of product in 45 litres of water is recommended at every 4 day intervals.

   (b) Tea recovering from pruning:
   276-420 g in 170 L of water with a Knapsack Sprayer or in 30-45 L of water with a Mist Blower, per hectare, at 4 - 5 day intervals, are recommended up to the time of tipping.

   (c) Tea in plucking:
   280-420 g in 170 L of water using a Knapsack Sprayer or in 30-45 L of water using a Mist Blower, is recommended, at 7 - 10 day intervals, spraying to be done the day following plucking.

Baycor EC 300 which belongs to Triazole group of Fungicides has been tested successfully against Blister blight recently. Rate of application is 85 ml. of product per hectare. Baycor EC 300 has curative and protective action. Due to these reasons, Baycor EC 300 could be sprayed at extended intervals when compared with Copper based Fungicides.

2. Stem and branch canker, (Macrophoma theicola):
   Application of Baycor EC 300, (Bitertanol), and Benomyl WP 50% has been recommended at 0.05%, (50 g./ml. in 100 L of water).

3. Red root disease, (Poria hypolateritia):
   It is the most serious root disease observed in tea. Fumigation with Methyl Bromide is recommended. One pound of Methyl Bromide was applied to 200 square feet. In recent trials conducted by the T.R.I., it was found that red root disease could be effectively and economically controlled by combining normal cultural practices with the use of systemic fungicides. Baycor EC 300 at 0.15% was found to be effective. Nursery plants should be treated with 250 ml. of solution a week to 10 days before planting and thereafter plants should be treated with 250-300 ml. of fungicide solution at 3-4 month intervals up to one year from planting. Earlier Methyl Bromide D-D was used for the control of Red root disease.

GROWTH STAGE	RECOMMENDED RATE	DILUTION	
		HIGH VOLUME	LOW VOLUME
Nurseries	276 g	111 L at 4 days	
Tea Recoveries from pruning	276 g - 415 g	111 L at 4-5 days	27 L
Tea in Plucking Clonal Tea	275 g - 415 g	170 L at 5-7 days.	27 L

Average Cost per Hectare per Application:

2) Fungicides:

Disease/Product.	Cost per Hectare:
a) Blister Blight:	
Copper Oxychloride/ Copper Oxide	Cents 22 - 33
Baycor EC 300	Cents 76
b) Red Root Disease:	
Methyl Bromide	Rs. 38,500/-
Baycor EC 300	Rs. 16,700/-

THE USE OF INSECTICIDES IN TEA

46 species of insects and 4 species of mites have been identified. Shot-hole borer and livewood termites are the most important pests followed by tea tortrix. Before the early 1950s insect and mite control in tea was based mainly on cultural practices and biological control. However, from the early 1950s incidence of pest problems increased due to various factors and in the same period the use of insecticides was initiated. Recommended insecticides for the control of insects in tea are as follows: -

1. Shot-hole borer, (Xyleborus fornicatus):
   Lebaycid EC 50% (Fenthion) - Organophospate - at 4.5 L in 1000 L of water per hectare at 12 - 14 months from prune in the low country, (600 m and below), and 14 - 16 months from prune in the mid-elevation, (600 - 1200 m), is recommended.

   Incorporation of Curaterr 3% G, (Carbofuran), at planting is recommended which also helps to protect stem and roots from other pests.

   The use of Lebaycid EC 50% for the control of shot-hole borer started in the late 1970s, (1975), after the withdrawal of Heptachlor which was used from the late 1960s. Before that Dieldrin was used for this purpose.

   There should be a minimum of 4 weeks interval between the last spraying and the harvest.

   Pre-Harvest Interval - 4 weeks.

2. Tea Tortrix, (Homona Coffearia):
   a) Trichlorphon (Dipterex) EC 50% - Organophospate - at a rate of 3.2 L in 250 L of water with a Mist-Blower or in 900 L of water per hectare with a Knapsack Sprayer.

   b) Methomyl (Lannate) 90% SP at a rate of 420-550 g. in 900 - 1000 L of water per hectare are recommended. Use of a Mist Blower with Methomyl is not recommended. Trichlorphon and Methomyl were recommended in the mid 1970s. Previously DDT was used for the same purpose.

   Pre-Harvest Interval: 2 weeks.

3. Mites:
   Red spider mite, (Oligonychus coffeae),
   Scarlet mite, (Brevipalpus californicus),
   Purple mite, (Calacarus carinatus),
   Yellow mite, (Hemitarsonemus latus),
   are observed.

   Dicofol 42% MF, (Organochlorine Compounds - Chlorinated Hydrocarbons), at a rate of 750 ml/ha or Dicofol 17 % at a rate of 1500 ml/ha or Morestan WP 25 % (Quinomethionate), at 550 g/ha and Tetradifon (Tedion V 18) (Organochlorine), at a rate of 1.5 L/ha, are recommended. 900 L and 170 L of spray to be used with a Knapsack Sprayer and Mist Blower, respectively.

   Pre-Harvest Interval: 2 weeks.

   The harvest collected from sprayed areas in the 3rd week should be mixed with ten times the amount of flush from unsprayed areas.

TEA, *(Camellia sinensis)*

PESTS	RECOMMENDED PRODUCTS	DOSAGE/ ha.	VOLUME OF WATER L/Ha.	
			LOW VOLUME	HIGH VOLUME
Shot-Hole Borer *(Xylaborus fornicatus)*	Lebaycid EC 50% Carbofuran 3% Gran.	4.5 L 10 g./ planting hole		1000
Tea Tortrix *(Homona coffearia)*	Diptere EC 50% Methomyl 90% SP (Lannate)	3.2 L 420–550 g.	250	900 900–1000
Meadow Eelworm *(Pratylenchus loosi)*	Nemacur 5% G Carbofuran 3% G	10 g./bush in mature tea 7 g./planting hole at time of planting.		
	Nurseries:			
	Methyl Bromide	454g./900 soil filled poly-thene bags or 454 g./2.8 m3		
	Dasomet 98% G (Basamid)	500 g./2.8 m3 or 10 g./1 m2		
Mites – Red Spider Mites	Dicofol 42%	750 ml.	170	900
Scarlet Mites	Morestan WP 25%	550 g.		
Yellow Mjtes	Tetradifon 18%	1.5 L		
Termites	Methyl Bromide Carbofuran 3% G	1 kg./40 m3 7 g./planting hole at time of planting		

Average cost per hectare per application

Insecticides: Insect/Product.	Cost per Hectare.
a) Shot-hole Borer:	
Lebaycid EC 50%	Rs. 1,210/-
b) Tea Tortrix:	
Dipterex EC 50%	Rs. 544/-
Methomyl SP 90%	Rs. 600/- – Rs. 787/-
c) Mites:	
Morestan WP 25%	Rs. 176/-
d) Nematodes:	
Nemacur 5% GR.	Cents 27 / Plant.
Curaterr 3% GR.	Cents 23 / Plant.
Dazomet 98% GR.	Rs. 1/40 Sq metre (Nursery)
In mature tea the cost per plant is approximately 43% more.	

THE USE OF NEMATICIDES IN TEA

Nematodes:
Root knot nematodes, (*Meloidogyne* spp)
Root lession nematodes, (*Pratylenchus* loosi)
are the most important.

Control in Nursery:
Dazomet 98% (Basamid) at 500 g per 2.8 cu.m. of soil is recommended. Application is done 5 weeks before planting the cuttings. In nursery beds Bazomet 98% G is used at a rate of 10 g/sq metre.

Control in Young Tea:
Application of Phenamiphos 5% G (Nemacur 5% G) and Carbofuran - Carbamate - (Curaterr 3% G3, Furadan 3% G), is used at a rate of 7 g/planting hole at the time of planting. Fensulfothion 5% G, (Terracur P), was used for the same purpose earlier, which is not marketed now. Nemacur 5% G has been used from mid-1980.

Control in Mature Tea:
Application of Nemacur 5% G, (Phenamiphos), and Curaterr 3% G, (Carbofuran), have been recommended from early 1985. Nematicides are applied with first application of fertilizer at tipping time after pruning and recommended rate is 10 g of nematicide/bush.

Pre-Harvest Interval: 10 weeks.

THE USE OF PESTICIDES IN RUBBER

When compared with Tea, the use of Pesticides in Rubber is very limited. Following pesticides are used:

Fungicides:

1. Oidium leaf disease, (*Oidium heveae*):
   Sulphur Dust was used for the control of Oidium leaf disease, at 4 kg per hectare. During heavy disease incidence, Sulphur dusting was practised at 6-7 day intervals for 5-6 weeks. However, Fungicide application is now not practised as the disease is not economically important.

2. Colletotrichum leaf disease, (*Colletotrichum gloesporiodes*):
   Fungicides are used in nurseries to protect the young seedlings. Baycor EC 300, Benomyl WP 50% and Carbendazim, are found to be effective against this disease.

3. Bark rot, (*Phytophthora meedii* and *Phytophthora palmivora*):
   Antimusin (Mercury Oxide containing 185 g/L and Barkson (1.2% of Antimuzin), are used to paint the tapping panels.

4. White root disease, (*Rigidiporus lignosus*):
   20% Pentachloronitrobenzene is used against this disease.

Insecticides:

Use of Insecticides in rubber plantations is negligible as generally rubber plants are free from serious pest attacks.

Weedicides:

Weedicides are also not much used in Rubber Plantations since cover crops are grown in many plantations.

Paraquat could be used at 1.5 - 2.0 L per hectare. The spray should not come in contact with the foliage of the rubber plants.

MSMA (Monosodium methanearsonate) (Arsenic Compound - Contact type Weedicide which controls broad leaf and grasses) + Amitrole (Miscellaneous compounds - translocate type controls grasses and broad leaf), MSMA + 2,4-D (Amine) + Dalapon mixtures, were earlier recommended.

Stimulants:

Ethrel, (Ethaphon) - It releases C_2H_4 into the plant tissues thereby keeping the latex cells open for a longer time which increases the yield.

THE USE OF PESTICIDES IN COCONUT

The use of pesticides in Coconut Plantations is limited in comparison to Tea and Rubber. Pesticides are used on a limited scale as follows:

Pests:
Most of the insects found in coconut are successfully controlled by biological methods:

e.g. Coconut caterpillar, (Opisina arenosella)
Coconut leaf-miner, (Promecotheca cumingi)
Insecticides are used on a limited scale for the control of the following pests:

(1) Red weevil, (Rhychophorus ferruginous):
Metasystox R EC 25% (Oxydemeton-methyl) is recommended at a rate of 20 ml. of product/tree applied as a trunk injection.

(2) Termites (Odontotermes spp):
Aldrin, Chlordane 40% EC, are recommended.

(3) Black Beetle (Oryctes rhinocerus):
Aldrin and BHC Dust 10% were used earlier. However, these pesticides are not used now.

Fungicides:

No fungicides are used.

Weedicides:

Total weed-killers, like Paraquat, are used on a limited scale for weed control. However, weed control is mainly done by using cultural practices/manual weeding.

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POISONING WITH CHEMICALS AND HAZARDS OF PESTICIDES

by

Miss Dharshini Perera

INTRODUCTION

Pesticides are special formulations of Organic/Inorganic chemicals. These chemicals are chosen for their selective lethality to pest organisms, (i.e. weeds, insects, fungi, algae,...) and are branded according to their specific uses like insecticides, fungicides, weedicides, and so on. Thus, we see that a large range of pests need to be controlled and therefore, the imperative need for a wide range of chemical preparations.

In the context of today's agricultural development, chemical formulations have gained an upper hand over natural control systems and as a result, a large number of chemically formulated pesticides have come into everyday use.

As expected, chemically formulated pesticides have negative environmental consequences. In some pesticides, the quantum of destruction is known, but in most cases, studies are still underway to determine the full effects.

Pesticides are mainly of three types

- Inorganic Pesticides (e.g. arsenate and mercury compounds)
- Organic Pesticides - These mostly grew out of research done on chemical warfare during the Second World War.
- Organometallic pesticides (e.g. Mercury and Tin compounds.)

Besides these, there are also the natural chemicals like Pheromones and Hormones.

Organic Pesticides

These are further classified as:
Organophosphates, Organochlorines, Carbamates, Paraquat, 2.4-D and 2.3.5.-T.

The degree of toxicity of the above types is difficult to determine, but in general, Organophosphates are the most toxic. However, during their manufacture and formulation, they all pose the same hazards.

The toxicity of pesticides is normally measured by the 50% lethal dose, which can be defined as:

LD 50: The dose necessary to kill 50% of a group of test animals (usually rats), and is expressed in milligrams of substance per kg of body weight.

At present, there are about 117 organic chemicals in use in more than 200 formulations in the Sri Lankan market. Many of these are used in agriculture and animal husbandry, and are highly toxic to living organisms. Thus, they are a potential risk to humans and beneficial organisms.

Pesticide formulations are used even in home gardens and some common ones like Baygon and Shelltox are used in the domestic scene in the control of household pests.

Hazardous Nature of Pesticides

Pesticides can be inhaled, ingested or absorbed through the skin. The greatest risk of occupational exposure is through the skin. In non-occupational cases, oral ingestion is the most frequent route. In Sri Lanka, the largest number of deaths due to pesticide poisoning is from suicide.

The toxicity depends on the formulation and the mode of use. Some chemicals may be safe in some formulations, while being quite dangerous in others. Sometimes the liquid formulation may be more dangerous than the granular form. Appreciable (and thus harmful) amounts may remain in the environment for as long as 50 years, as in the case of DDT, depending on the soil and climatic conditions.

The hazards very often increase greatly because of the presence of other pollutants through what is called synergistic interactions. This problem of synergistic effect is specially acute in DDT. Recently it was discovered that minor virus diseases like the flu and chicken-pox can become

fatal when combined with exposure to pesticides like DDT.
Farmers are not the only people whose health is endangered by the large scale use of pesticides in agriculture. Risks arise at any stage of use. For example containers can be damaged in transit, leading to contamination of food or those handling the consignment. In agriculture, workers who load and maintain spraying machinery may be splashed while opening the containers and may inhale the mist or dust or could even swallow traces in their fingers. Children may "accidentally" taste pesticides (out of curiosity?) or may play in fields sprayed with pesticides.

Finally, there is the industrial hazard, both in the working and ambient environment. Poor protective measures affect the workers. Distributors and retailers involved in repacking the poisons, workers who dilute and mix the concentrates are mostly at risk. Accidental spillages and emissions are a potential danger to residents close by. Fortunately in Sri Lanka, there are no plants that manufacture pesticides. The various chemicals are imported and only the formulation take place. Recent legislation has restricted the import of certain chemicals to this country, but many potentially hazardous ones are still freely available in the market.

Estates and plantations contribute to bring about the worst situations. Here, pesticides are bought for their toxicity and potency, and most estates do not provide the necessary protective equipment.

Organophosphates

These are a popular group of insecticides, most frequently involved in human poisonings. In 1981, these were responsible for 76 % of the total poisonings in Sri Lanka.[1)]
The pesticides Parathion and Malathion come under this group. They are known to persist for upto a year in roots or foliage. Insects feeding on the plant are poisoned by the insecticide inside the plant and not on the surface.

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1): Ponnambalam, M. "Some applied toxicological aspects of pesticides"

Organophosphorous compounds vary in their acute toxicity to animals:

e.g.: Parathion: LD50 = 13 mg/kg
Malathion: LD50 = 2,100 mg/kg

However, their mode of action and the symptoms are the same.

Organophosphorous compounds affect the transmission of nerve impulses at synapses (nerve endings). Under normal physiological conditions, during the transmission of nerve impulses, the neurotransmitter acetylcholine is hydrolysed to Choline:

Acetylcholine ___Choline Esterase___> Choline

The enzyme catalysing this reaction is an esterase enzyme.

Organophosphorous compounds inhibit this enzyme irreversibly. As a result, acetylcholine gets accumulated at nerve endings, giving rise to a series of other clinical manifestations, which in acute cases, can lead to coma and paralysis. Thus, one way of detecting unsafe working conditions and pin-pointing the causes of such conditions is to measure the level of the esterase enzyme in the blood of the workers. It is recommended that if the enzyme level is less than 25%, the worker be removed from his exposure.

Organocarbamates

These are derivatives of Carbamic acid and are used in many different situations, including the home (Baygon), garden and the farm. The target of these is also the esterase enzyme. But, unlike Organophosphates, they inhibit the enzyme reversibly.

Organochlorines

These are also a group of insecticides which do not breakdown easily into harmless compounds. Once applied, they remain in the environment for long periods and find their way into waterways, air, soil and up the food chain.
Organochlorines include DDT and its related compounds like DDE, Cyclodienes, BHC.

DDT which was economically important once, became popular after the Second World War. It was over-used and abused until eventually it was banned. One harmful aspect of DDT is that it created resistant strains of the Malaria mosquito. A population of mosquitoes bounced back even in greater numbers than originally present. It became a case of "survival of the fittest".

DDT, being fat soluble also accumulated in the food chain, thus being detrimental to wild life.

Organochlorines cause depression of the central nervous system.

Pesticide Poisoning

Statistics reveal that about 1,000 workers are poisoned each year from poisonous chemicals in Sri Lanka. A survey in 1983 showed that out of 407 pesticide poisonings, 373 were suicidal and 29 were from occupational exposure.

In Sri Lanka, about 10,000 workers are exposed to pesticides in antimalaria and antifilaria operations. A study revealed that workers spraying Fenthion for filariasis control frequently suffered from pesticide poisoning.

Such cases of poisoning happen because of the way pesticides are distributed in this country. Distributors who trade in pesticides also sell items like cigarettes, flour, oil and even baby food. Therefore, it is not surprising that mass food poisoning cases have occurred.

Most occupational poisonings in Sri Lanka seem to affect cultivators of rice and vegetables, and it is among the mass of poor farmers that pesticides take their toll.

Pesticides and the Environment

Improper use of pesticides may be unprofitable, ineffective or even counter productive at least in the long run, if not immediately. The pest's natural enemies are killed by the pesticide and the pests themselves may develop the ability to resist the action of the chemicals, as was the case with DDT. Thus a kind of addiction can set in, where the farmer finds that he must apply more and more powerful insecticides to prevent devastating crop losses. So, a "pesticide treadmill" is created. Pesticides like Chordane, Endrin and Hepatachlor are very toxic to earthworms who play an important part in circulating and aerating the soil.

In the ecosystem, through the food chain, pesticides often bioaccumulate due to their water insolubility and fat solubility, especially in the case of Organochlorines. So, when these are ingested directly, or when it is a part of another animal or plant, this goes up the food chain. Studies have shown that birds of prey and other organisms high in the food chain have concentrations of DDT ten million times greater than those in the water or air environment. Pollination and the reproductive processes of birds and other animals are also affected as a result of this bio-accumulation.

Pesticides washed into rivers get rapidly absorbed by sedimentation, and the aquatic species therein. In small concentrations, pesticides are fatal to the fish.

It is obvious that careful control and use of pesticides is essential to avoid all kinds of hazards to animals and even to human life, thus ensuring maximum benefits.

EFFECTS OF AGRO-CHEMICALS ON HUMAN BODY

by

Dr. Ravindra Fernando

Agro-chemicals include basically two groups of chemical substances namely, pesticides and fertilizers. Though either of these can cause poisoning or other adverse effects if misused, as a group, pesticides are the major group of substances causing human toxicity today.

Pesticide means any substance or mixture of substances intended for preventing, destroying, or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport, or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs or which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies. The term includes substances intended for use as a plant-growth regulator, defoliant, desiccant, or fruit thinning agent or agent for preventing the premature fall of fruit and substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport.

By definition therefore, pesticides must kill pests which are living organisms. If misused they must be harmful to man. If there is a pesticide that is not harmful to human beings, that is not a pesticide.

Pesticides have five main areas of use in Sri Lanka. They are widely used in public health programmes to kill vectors of malaria and filaria. In 1984, the Anti-Malaria Campaign imported two million kilograms of Malathion and the quantity is increasing because although in early 1960's Sri Lanka had no cases of malaria, there are about 400,000 to 500,000 cases today. At this rate it will not be "Health for all by the year 2000" but "Malaria for all by the year 2000". It is tragic that even the dangerous type of cerebral malaria cases are now seen at the General Hospital, Colombo. People have died of cerebral malaria and people are getting malaria even in the city of Colombo.

Secondly, we use pesticides for domestic and personal use for application to kill insects such as cockroaches; or on the skin to control scabies or head-lice. Thirdly, we use pesticides for industrial use like fumigation of houses, ships and buildings. Fourthly, we use pesticides for protection of material by incorporating in/on paint, timber, glue, and leather to prevent or retard attacks by insects or fungi. Finally in agricultural production, pesticides are used on agricultural produce, on garden crops, forests and livestock.

The effects of pesticides on man can be acute or chronic. The major problem in Sri Lanka is acute toxicity. The gravity of the problem of poisoning with pesticides can be seen in the following statistics:

DISCHARGES FROM HOSPITALS, AND DEATHS IN HOSPITALS FOLLOWING POISONING - 1984

	Discharges from poisoning	%	Deaths	%
Chlorinated hydrocarbons	2955	(12)	319	(14)
Organophosphates and Carbamates	9967	(39)	931	(42)
Other Pesticides	3163	(13)	209	(09)
Medical Agents	2125	(08)	94	(04)
Other Poisoning and Toxic effects	7073	(28)	697	(31)
	25242		2250	

The number of deaths from pesticide poisoning, surprisingly, is more than the total number of deaths from rabies, snake-bites, polio, diphtheria, tetanus, whooping cough, malaria, and all murders in 1984 (more than the combined total of all those causes of deaths).

We have data on all hospital admissions for pesticide poisoning in 1979 reported in the bulletin of the World Health Organization (WHO) in 1982 by Dr. Jeyaratnam and others, which revealed that 73% of cases were due to deliberate ingestion. 17% cases were occupational, 8% were accidental and in 2% the cause was not ascertainable from the hospital notes. This study also revealed that of all the poisoning cases 31% involved people between 11 - 20 years and 47% between 21 - 30 years; in other words 78% cases are between 11 - 30 years.

Annual morbidity rate for pesticide poisoning is 79 cases for 100,000 population. This study further showed that 5 per 1000 of agricultural workers are hospitalized annually for pesticide poisoning. These revealing data show that Sri Lanka probably has the highest rate of pesticide poisoning in the world! Normally poisonings in world literature shows about a 5% mortality rate but our mortality is around 9 - 10% which is unacceptable and something should be done to reduce the mortality to around 5%.

Accidental and occupational poisoning can occur under special circumstances. Firstly, they can occur during research work in the laboratories. During field studies people can get accidentally poisoned. Secondly, during production of the pesticide, manufacturing, packaging and waste disposal can cause occupational poisoning. Poisoning can occur also during transportation. Storage of human and animal food can cause poisoning, and finally poisoning can occur during spraying. Poisoning due to deliberate ingestion is very common in Sri Lanka because of the easy availability of highly concentrated pesticides. Homicidal poisoning is extremely rare.

Common pesticides involved in poisoning are:

(1) Organophosphates such as Malathion, Methamidaphos, Monocrotophos, Fenitrothin
(2) Carbamates
(3) Organochlorines - such as DDT and Benzene hexachloride
(4) Pyrethrum
(5) Paraquat
(6) Rodenticides - Zinc Phosphide (Run rat) and Thallium
(7) Miscellaneous - Sodium arsenite, copper-containing fungicides, etc.

Explained briefly are the problems regarding management of patients who have been exposed to pesticides:

(1) Undue delay in admission.

(2) Lack of proper first-aid prior to admission.

(3) Delay in the treatment after admission.

(4) Improper attitude of medical and para-medical personal especially for suicidal poisoning cases.

(5) Lack of drugs and equipment necessary for proper treatment.

(6) Wrong treatment due to the inability of correctly identifying the pesticide involved.

(7) No psychiatric referral prior to discharge from hospital in attempted suicidal cases.

The WHO project proposal to write a book on first-aid treatment in poisoning was sent to us for comment on the situation here. Initially the book will be published in English. Later, funds will be made available to translate it into the national languages.

The other important aspect is Research. We have to carry out research on occupational poisoning; to do research on the clinical aspects of poisoning - how to prevent people from dying; and we have to undertake a study on the long-term effects of the use or rather misuse of pesticides in Sri Lanka.

PEST MANAGEMENT STRATEGIES IN TEA PLANTATIONS

by

Dr. P. Sivapalan

The term "Agrochemical" refers to all those chemical compounds that assist in the successful cultivation of agricultural commodities. These chemicals include fertilizers, growth promoting substances and hormones, as well as pesticides. Pesticides include a wide range of compounds that are specifically effective against individual groups of organisms that impose various forms of limitations and restrictions to crop productivity. These include, among others:

Acaricides	-	against mites
Bactericides	-	against bacteria
Fungicides	-	against fungi
Herbicides	-	against weeds
Insecticides	-	against insects
Nematicides	-	against nematodes

All these chemicals, including chemical fertilizers, have varied effects on the environment. Despite such environmental influences we have come to depend rather heavily on the use of such chemicals for the successful cultivation of crops and to increase their productivity. The plantation sector is no exception to this rule.

When we consider the plantation sector as a whole, it is in the tea sector that the largest amount of agrochemicals are consumed annually. At one time the largest amount of pesticides was also consumed by the tea sector. However, research efforts undertaken by the Tea Research Institute of Sri Lanka are providing handsome dividends by quite successfully curtailing the use of and moving away from unilateral dependence on pesticides to sound, ecologically acceptable pest-management strategies. Pesticides that are recommended at present are those that cause the least ecological disruptions.

Amongst the various pesticides used in the tea sector, insecticides were the ones that dominated the scene, especially during the 1960s and early 1970s - (the so-called dark ages of insecticides).

Before I describe some of the strategies of pest-management, I would like to trace the evolution of pest problems in agro ecosystems, in order to emphasize the fact that in our endeavours to raise productivity of crops we have also created situations most ideally suited for the build-up of pest species. If one can understand this from an ecological point of view, it would then become easier to appreciate the need to develop sensible ecologically acceptable strategies to manage pests, to levels below that which cause economic losses in crop productivity.

The tea plantations were once the abode of forests with an immense diversity of plant and animal species that had amongst themselves successfully established a delicate balance. As was the case with most agricultural ventures, these forests gave way to the establishment of a well regimented monoculture of tea plantations.

With the destruction of the forest and the establishment of this plantation crop, some of the organisms that had established a delicate balance within the complex of the forest ecosystem, became suddenly well adapted to this uniform and abundant supply of food with their consequent population explosion. This was especially so with those organisms whose complement of natural enemies could not adapt themselves to the new environment.

In time, the limited genetic diversity that existed in the early tea plantations that used seed tea plants, gradually gave way to more genetically uniform planting material, the new clonal selections, that were specifically chosen for high yields. Vast stretches came to be planted up with this highly narrowed genetic base and consequently, the adaption of specific pests and disease-causing organisms became even more intensified, with the resulting severe crop loss situation.

As in the case with most Agrotechnologists or Agricultural Scientists, who are forging their way towards the goal of increased productivity, the Tea Scientists, who are no exception to this rule, also kept forging their way towards

higher productivity, to cater to the ever increasing demand. Cultivable lands are becoming limited and much of those available are eroded and already over-exploited. There is no room for further horizontal expansion and it has become the responsibility of the Agrotechnologist to increase productivity to the maximum possible limit in the scarcely available land.

In this pursuit, various agro-techniques are innovated and implemented to achieve the ultimate goal of an economically attainable high productivity. Besides higher productivity, the Agrotechnologist has to be mindful in controlling the cost of production in such a way, that there is a reasonably attractive profit margin.

In any crop situation, there is a theoretical upper limit of maximum productivity, then there is the practically attainable upper limit, using the available technologies in the most economic manner and, finally there is the current productivity level. The farmer, the planter and the agricultural scientist constantly strive to narrow the gap between the current productivity status and the upper limit of economic productivity. In this endeavour, various manipulations and newer agro-techniques are being introduced from time to time. Most often, such newer and "improved" technologies tend to dislocate and destabilize the delicate and fragile ecosystem. Such an altered agro-ecosystem unfortunately for us, not only favours an escalation in various pest and disease outbreaks but also the growth of a multiplicity of weeds.

In order to avert any decline or depreciation in the productivity as a consequence of the competition posed by the now amplified pest species, disease-causing organisms and weeds, the agricultural scientist is unfortunately compelled to find solutions to minimize such losses. The scientist, the cultivator, the farmer, and the planter, look forward to various control strategies that could be economically harnessed to arrest such losses.

At a time when agricultural productivity was modest, pest and disease problems were not very serious and they were also manageable with the then available systems of control, including the planting of pest and disease resistant varieties, the threshold level of biological control activity, and by altering specific cultural practices. However, with the trend towards increasing the production levels by harnessing techniques that were mainly geared towards high productivity, the pest and disease situation became more complex and seemingly difficult to manage with the available resources of control, and crop losses also kept escalating. It was about this time that, with the advent of DDT into the agricultural sector in the immediate post-war period, a host of the so-called "miracle pesticides" became readily available to the cultivators, farmers and planters and these proved to be a boon to them. This fantasy was, however, short-lived.

Amongst the pesticides that have been in use over the past 40 years or so, insecticides were by far the most widely exploited chemicals and these dominated the agricultural scene for well over two decades. Various problems were encountered as a consequence of the wide-scale use of insecticides and these included the development of resistant strains, the outbreaks of hitherto unknown secondary pests and potential pests, resurgence of target insect species and the problems of pesticide residues in the harvest. Cases of accidental poisoning amongst users kept escalating, mainly on account of lack of knowledge and experience in the handling of such poisons. Indiscriminate use of such chemicals by inexperienced handlers have brought about pollution problems to danger limits.

The once venerated miraculous agrochemical is now looked upon with suspicion and fear and this has unfortunately led to another extreme situation, by the emergence of anti-pesticide crusaders, demanding a total ban on the use of agrochemicals, and urging the going back to "organic farming".

We should not get hysterical and throw the baby out with the bath water.

All these problems arose as a consequence of a unilateral dependence on pesticides to manage pest and disease situations. With the emergence of such a multiplicity of side effects and problems, there dawned a new sensible concept - the ecosystem approach - to respect and appreciate nature. This approach recognizes the rights and privileges of the

numerous beneficial organisms that help check outbreaks of the very same species of pest that we are attempting to control. We should accept the position that we have to live and let live. A certain amount of crop loss is an inevitable loss; and it is only when pest numbers build-up to what is now referred to as the economic injury level, that we have to take steps to avert such proliferation.

This sensible ecosystem approach harnesses the available resources of management and integrates them in a manner so as to cause the least disruption to the environment and at the same time helps check pest build-up to below the economic injury level.

Since amongst the pesticides used at one time in the tea sector, insecticides were the ones that dominated the scene, I shall confine my reference to a few examples of insect management strategies that we have successfully developed and which have helped the industry to break away from the shackles of a unilateral dependence on pesticides an yet achieve the ultimate objective of averting economic crop losses.

1. Reference to the management strategy developed to manage the low-country live-wood tea termite.

2. Use of metabolic disruptors in the diet of insects.

3. Use of sex pheromones for insect surveillance and forecasting outbreaks.

CARELESS HANDLING OF PESTICIDES

Even though every effort is made to recommend safer pesticides at required dosages and dilutions, the operators are inexperienced and at times even indifferent towards some of the basic precautions.

The balance pesticides are dumped at any convenient place, even into drains and ravines, without realizing or even bothering that it is only just a few yards away, that the same ravine is feeding a spout used for bathing and collecting water for cooking! The spray tanks are also washed and cleaned at such vulnerable places.

Another disturbing aspect is the manner of disposal of pesticide containers. The practice of auctioning empty containers, especially poly-cans, seems to be still going on in tea plantations. There was a recent newspaper notice by a state sector organization listing items to be auctioned, including empty poly-cans!

REGULATION OF IMPORT, FORMULATION, SALE AND USE OF PESTICIDES IN SRI LANKA

by

Dr. (Mrs.) Nalini de Alwis

The present legal basis for the regulation of pesticides in Sri Lanka is embodied in the Control of Pesticides Act No.33 of 1980. The implementation of the Act is vested in the Department of Agriculture. The licensing authority under the Act is the Registrar of Pesticides, on whose recommendations regulations are framed for the implementation of this Law.

Annexure I is a brief synopsis of the Act. You will note that the Law requires that every pesticide be licensed, and imports would be permitted thereafter on the recommendation of the Registrar.

Importation

Pesticides are imported into the country either as ready to use products (formulations in retail packs or in bulk for repacking) or as technical material for local formulation. Unfortunately, for Customs purposes, they are not classified under one BTN Number. The formulations of pesticides are grouped together under 38.11 a - e, while pesticide technical material is imported as chemicals and depending on their chemical structure, are grouped under various sub-categories of BTN Nos. 28 and 29. These BTN numbers also contain chemicals required for other industrial uses (textiles, cosmetics, paints, etc.). All local industries are required to be registered with the Ministry of Industries and Scientific Affairs. The raw materials required from abroad, depending on their nature, are imported either on Open General Licence or under Import Licence from the Ministry of Industries and Scientific Affairs.

All pesticidal products coming under BTN No. 38.11 are under full control of the Registrar, while as indicated above, technical material imported by local agro-pesticide industries under the BTN Nos. 28 and 29 are given an import licence by the Ministry of Industries and Scientific Affairs only on the approval of the Registrar. As this Ministry issues licences for every industry in operation in Sri Lanka, and as the Registrar has to approve the import of Pesticidal products, in effect, no agro-chemical can be imported without prior approval from the Registrar. I can assure you that Sri Lanka does not provide a dumping ground for undesirable agro-chemicals from the developed world by chemical companies having transnational links. I am unable to give the same assurance for pesticidal products like mosquito coils, aerosols, and so on for household use.

Annexure II is an extract from a Malaysian case study, where it was revealed that agro-chemicals which have been regulated in several countries in the developed world are freely available in Malaysia. I wish you to read the two footnotes before studying the Table. The symbol **X** does not always indicate that such products are banned. They could be permitted for specific uses in the country concerned. Using the 1986 issue of the UNCLP* as a guide, I have attempted to give you the actual regulatory status of several of these questionable agro-chemicals. Of more interest to you would be **Annexure III** where the regulatory status of these hazardous products, including the so-called "dirty dozen" is detailed for the South East Asian region, giving the regulatory action adopted in Sri Lanka in column **4**.

Formulation

The Licensing scheme for pesticides in Sri Lanka has been modelled on "The FAO guidelines for the Registration and Control of pesticides". A set of basic data which include the physical and chemical properties of the pesticide, bio-efficacy data (both local and/or from Tropical Asia) toxicology data and data on residues and their fate in the environment are mandatory. Formulations having the same active ingredient, but differing either in their chemical composition or physical state, are required to be registered individually.

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* Consolidated List of Products whose consumption and or sale have been banned, withdrawn, severely restricted, or not approved by Governments (2nd issue).

Certain pesticides are available as proprietary products where the principals who developed the product require confidentiality of registration data. The importing and marketing of these formulations are done by local firms who are affiliated to the parent company (e.g. Chemical Industries (Colombo) Ltd. for I.C.I.; Haychem Ltd. for Bayer; A. Baur & Co. Ltd. for Sandoz; and Harrisons & Crossfield (Colombo) Ltd. for Ciba Geigy). While products are under patent, the firms enjoy a monopoly of the formulation but quality standards are assured.

Special problems in registration procedures arise on the expiry of patents covering the manufacture and/or use of proprietary pesticides. When a patent expires new manufacturers and formulators often seek to exploit the market by offering products as copies of those previously covered by patent with or without altering the original manufacturing and cleaning process. Since the registration of the original pesticide product had been based on an extensive package of proprietary data submitted and developed at the expense of the patent owner, Registration authorities cannot in all good faith agree to register the copy on the basis of the data submitted by the original proprietor. On the other hand, Government authorities cannot deny farmers the benefits to be derived from commercial competition.

It is especially in this area that regulatory bodies need supportive analytical laboratories to monitor the composition, quality characteristics and shelf-life of commodity products to determine whether they comply with FAO specifications. In the absence of such monitoring laboratory facilities in Sri Lanka, currently, Quality Certificates indicating percentage of active ingredient and solvents and the shelf-life with date of formulation are required for every consignment imported from a new source.

Sale of Pesticides

Those pesticides which fall into the moderately less hazardous World Health Organization (WHO) classification and which have not been identified by International Register for Potentially Toxic Chemicals (IRPTC) as having carcinogenic risks are permitted to be marketed without restrictions but under an approved label. However, the highly hazardous WHO Class 1 A and B formulations and those potentially carcinogenic compounds are classified as Restricted pesticides (Annexure IV).

The restrictions that have been placed are of four types.

1. Sale restriction only to and through authorized persons	Fumigants and other WHO Class I A formulations.
2. Label restriction on use	Methamidophos, Pyrethroids, Chlordane, BHC, Aldrin.
3. Sale restriction on quantity	Aldrin, Chlordane, BHC, Pyrethroids.
4. Sale restriction for limited marketing	prior to full commerciali-zation on a regional basis

All restricted products have to carry the word "Restricted" in all three languages on the label. A scheme is now underway to educate and licence dealers who sell such products. They are required to record all stocks and sales, and they must sell restricted products only to bona fide farmers. This is one of the measures that are being adopted to keep pesticides with high oral toxicity from being freely available to those who use these for suicidal purposes. With a view to complete cancellation of Class I agro-chemicals, Research programmes are underway to find safer alternatives such as less hazardous pesticides, microbial pesticides, resistant crop varieties, manipulation of agronomic practices to reduce pest build-up and to multiply and distribute or encourage activity of natural enemies of plant pests.

Use

It is mandatory that the label (legal requirement) gives amongst other items, sufficient information on use directions, that is, when and how much to use, the period of potency, the preharvest interval and precautions to be taken in spray preparation and in application. Prior to a product being licensed, the Registrant must submit a draft label for approval, and the directions for use have to be consistent with those recognized by Research and Advisory institutions in Sri Lanka. (Currently all labels are required to be in all

three languages, with a minimum print size of point 6.) However, the most significant problems facing Extension officers is the compliance of farmers in the correct use of Pesticides.

In 1985 a survey was carried out of farmer practices in the usage of pesticides in vegetable growing areas of Nuwara Eliya, Badulla, Kandy and Matale. Annexure V illustrates the extent to which farmer practices deviate from the norms that had been laid down for the judicious use of pesticides. As an outcome of this survey, the Department of Agriculture has intensified its training programmes on decision making in the use of pesticides, the safety precautions to be followed in storage, spray preparation, application, personal hygiene and destruction of empty containers.

In comparison to the peasant farmer, the state employees who are deployed in pest control activities come under closer supervision by the Management and as such, it is expected that misadventures and mishandling of pesticides by plantation spraymen would be on a much lower scale. However, the necessity for a seminar on this theme is an indication that lapses in the education on safe use of pesticides also occur in this sector of agriculture.

ANNEX 1

CONTROL OF PESTICIDES ACT, NO 33 of 1980

Art. 3&4	Licencing Authority for pesticides	1) Pesticides have to be licenced by the Registrar of Pesticides, who is advised by a Pesticide Formulary Committee and is responsible to the Director of Agriculture.
Art. 6	Application for licence	2) In making application for registration of a pesticide, the trade name, the proposed label, sample of the container, uses, potency, shelf-life and effect, chemical identity, stability in storage, date of expiry for usage, toxicological data including information on antidotes of pesticide are, *inter alia* required to be stated.
Art. 7	Consideration of application	3) Licences issued after consideration are not permanent but renewable, which is conditional upon review by the Registration of the data on the pesticide.
Art. 8	Issue of licence	4) (a) For issue of licence, the proposed labels of the pesticides submitted with the application must contain in Sinhala, Tamil and English *inter alia* the following particulars: trade name, common names of the active ingredients in letters not less than half the size of the trade name and placed immediately below, name and address of the licence holder, directions concerning use, period of time which should elapse between last application of the pesticide and harvest of the crop to which it is applied, adequate warning and precautionary symbols and statements including first aid and antidote

		information, the statement "Registered under the control of Pesticides Act, 1980" which shall be an official symbol that the pesticide has been licenced under this Act and the licence number assigned by the Registrar. (b) No change of these particulars can be made without prior approval of the Registrar.
Art.	Approved container/ package	5) Approval of the Registrar of a pesticide relates also to its container/ package in respect of such container/ package being satisfactory in relation to the conditions required for safe and effective storage and handling of the pesticide.
Art. 12	Alteration in package of composition of pesticide	6) No alteration in the package, label or composition of a pesticide shall be made by the holder of a licence without further approval by the Registrar upon application.
Art. 14-17	Prohibition	7) a) No person shall manufacture, formulate, pack or distribute, sell or deliver any pesticide unless its container/ package is licensed and if it is adulterated, decomposed or deteriorated. b) No person shall store, transport, sell any pesticides in close juxtaposition with the feedstuffs or in such a manner as to contamination of feedstuffs.
Art 18	Advertisement of Pesticide	8) a) Advertisements of pesticides have to conform to the particulars relating to it as approved by the Registrar when issuing the licence - *vide* para 4 above (Art.8)

b) it is unlawful to advertise any pesticide in a manner that is false, misleading or deceptive and not justified by the conditions of its registration.

Art. 19	Storage of pesticides	9)	No person shall store pesticides in bulk other than in a special store kept for that purpose. The store shall be kept locked when loading/unloading is not in progress and a notice must be displayed in a conspicuous position outside the store indicating the hazardous nature of its contents.
Art. 20	Harvesting of crops	10)	No person shall harvest/offer for sale any food crops in which pesticides have been used unless the time limit prescribed by regulations has elapsed between such use and harvest or if the food crops contain pesticide residue in excess of levels as prescribed.

Authorized Officers and their powers and functions.	21. (1) The Director shall nominate such numbers of officers of his department as may be necessary to carry out the purposes of this Act, who shall be known as "Authorized Officers".

INADEQUACIES IN IMPLEMENTING THE CONTROL OF PESTICIDES ACT NO 33

Implementing an Act is dependent on the support it receives for enforcement. It requires trained manpower i.e. expertise and skills for evaluating and analysing data as well as pesticidal formulations and for policing of pesticide use in the fields, supporting laboratory and field facilities for monitoring and implementing the Act and adequate funds.

The office of the Registrar now consists of two Technical officers; (A Registrar on contract basis and an untrained Graduate recruited as an R.O.), 2 Clerks, 2 Typists, and 2 Minor Employees. The provision in 1987 on staff emoluments is Rs. 188,000/-, recurrent expenditure Rs. 344,000/-, Capital expenditure Rs. 50,000/-.

The main thrust in the work of this Unit has been the setting up of the registration process, i.e. for the import, distribution, and sale of pesticides for Agricultural and Public Health Purposes. Registration involves submission of necessary data on active ingredients and formulations: on their bioefficacy, toxicology, residues and fate in the environment, and the subsequent evaluation by experts. Highly supportive of this Division is the Pesticide Formulary Advisory Committee. However, this body lacks expertise in evaluative toxicology and on herbicide activity patterns.

Ater a pesticide is registered, a wide range of monitoring and other activities are required to ensure that a pesticide is being handled, distributed, and used properly in accordance with label directions and in compliance with rules and regulations. These activities include:

(i) Monitoring of Pesticide outlets to ensure compliance with rules and regulations to be observed when storing pesticides in general and when selling restricted pesticides.

(ii) Detecting of unauthorized packing, repacking, and labelling activities to enforce legal action and to weed out substandard or hazardous products from entering the market.

(iii) Analysis of formulations for maintaining quality standards and determining if surplus or unmarketed quantities of pesticides are still useable for their intended function.

(iv) Establishing maximum limits for pesticide residues on various crops and commodities based on experimental data derived under good agricultural practice to ensure safety in dietary intake. The data could also provide the basis for modifying use patterns.

(v) Analysis of crops and commodities for pesticide residues to provide information that can be used to assess the safety of consuming treated foods, detecting residues from improper use of pesticides and to facilitate export trade in food commodities.

(vi) Monitoring pesticide poisoning cases due to exposure during formulation, packing and use.

Information on these aspects can be a basis for active training for informational needs and for other regulatory purposes leading to restricting the use of, or totally banning products found unsuitable under our socio-economic conditions, or to taking enforcement action against pesticide misusers.

The first two of the activities given above are the responsibility of the Authorized Officers. (DA has nominated 32 officers at the district level to enforce legislation, in addition to their other duties). Inadequate laboratory facilities prevent the accomplishment of activities (iii), (iv), and (v). While the proposed establishment of a Poison Centre by the Health Services would go a long way in monitoring cases of occupational poisoning due to pesticides.

The post-registration activities are an inherent part of Sections 20-22 of the Act which enables the evaluation process necessary to safeguard food production and the health of the nation. These activities would enable a full evaluation of risks associated with the use of pesticides and to take action to cancel, revoke, restrict questionable pesticides, or to revalidate the licences of others.

Legal enforcement can be strengthened with the upgrading of the Registration Unit and the Analytical laboratories (with skilled manpower, adequate field and laboratory facilities and sufficient funding), and the recruitment of a full time Authorized Officer cadre for monitoring activities in the field.

Annexure II

Indexed from UNCL
B = Banned
HR = Highly Restricted
R = Restricted

PESTICIDES BANNED, WITHDRAWN OR RESTRICTED IN USE IN VARIOUS FOREIGN COUNTRIES

Country	Aldrin	BHC/ Lindane	Chlordane	DDT	Dieldrin	Endrin	Heptachlor	Kepone	Leptophos	Organic Mercury Compounds	Parathion	2,4,5–T	TEPP	Strychnine	TDE	Camphechlor	Toxaphene
Algeria			X		X		X									X	
Argentina	BX		HRX	BX	HRX	HRX	HRX										X
Australia			X	X			X			X		X		X			
Austria	HRX		X	X	HRX	HRX	X							HRX			
Belgium	BX		RX	X	X	BX	BX										
Brazil					X				X	X							
Bulgaria	BX	X	X	BX	BX	BX											
Canada	HRX	X		RX	HRX	RX	HRX		BX			HRX				HRX	
Colombia				RX				X		HRX				X			
Costa Rica				X					X	X							
Denmark	HRX	X	BX	BX	BX	BX	BX		BX	RX		BX			X	BX	
Finland	BX	X	BX	BX	BX	BX			X			BX				BX	X
France	X	X		X		X	X			X				X		X	
W. Germany	BX	X	BX	HRX	X	BX	BX			X		BX				BX	X
Greece	X		X	X	X	X	X										
Guatemala				X				X	BX	X		BX		X			
Hungary	BX	X	X	BX	BX	X	X				HRX	BX			X	X	
India					RX	BX			BX		X	BX				BX	
Italy	X	X	X	X	X	X	X			X	X	X				X	X
Japan	HRX	X	BX	HRX	HRX	HRX	X			X	BX	BX	X				
Mexico	X		X	X	X	X	X	X	X	X				X			
Netherlands	BX	X	X	X	X		X			X		X			X		
New Zealand	HRX	X	X	RX	RX	BX	BX		BX		HRX	HRX				BX	
Norway	BX		BX	BX	X	X	X				X	BX					
Philippines	HRX	X	X	HRX	RX	BX	HRX		BX		X	HRX		BX		BX	
Poland		X	X	HRX	X	X	X										
Portugal	BX	X		BX	X	X	BX										
Spain	X	X	X	X	X	X	X			X	X	X					
Sweden	BX	X	BX	BX	BX	BX	X				BX	BX	X				
Switzerland	X	X	X	BX	X	X	X									HRX	
Thailand				X		X			BX							BX	
Turkey			X	X	BX	X	X		BX		X	BX				HRX	
U.K.	HRX		HRX	BX	HRX	HRX	X	X			X			X	X	X	
U.S.A.	HRX	X	HRX	HRX :	HRX	BX	HRX		X	HRX	X	BX		HRX	X	HRX	
U.S.S.R.	X	X		X			X				X	X					

GAO Note: This list should not be construed to mean that pesticides are necessarily used in countries above that have not banned or restricted their use. Some countries may never have permitted use and, therefore, would not have need to ban or restrict the pesticides. Others may very well use them. However, we could not document this generally as most countries could not or would not provide us data on their pesticide use.

Source: Pesticide Dilemma in the Third World – Case Study of Malaysia, by Sahabat Alam (Friends of the Earth) 1984.

Additional Information is through the UN Consolidated List of Products whose Consumption and/or Sale have been Banned, Withdrawn, Severely restricted or not approved by Governments and other sources.

Annexure III

Pesticides banned or restricted for agricultural uses in selected countries in South East Asian region (includes pesticides identified as too hazardous by PAN[1])

Pesticides	Restricted in	Banned in	Status in Sri Lanka in 1987
Aldicarb	Philippines Sri Lanka Thailand Rep. of Korea	——	Highly Restricted
* Aldrin, Dieldrin * Chlordane, Heptachlor	All countries except, Rep. of Korea	Republic of Korea	Highly Restricted Highly Restricted Phased out
Arsenates (Ca/Pb)	——	India	Not Registered
Arsenites (Cu/Sodium)	——	Philippines Thailand	Not Registered
Azinphos methyl/ethyl	——	Thailand India	Not Registered
Binapacryl	——	India	Not Registered
* BHC & Isomer	Philippines Sri Lanka	Bangladesh Thailand Indonesia Republic of Korea	Highly Restricted
* Camphechlor	——	——	Not Registered
Carbophenothion	——	India	Registration Cancelled
* Chlordimeform		Pakistan Thailand	Not Registered

Pesticides	Restricted in	Banned in	Status in Sri Lanka in 1987
* DBCP	—	All 9 countries	Not Registered
* DDT	—	Bangladesh Malaysia Indonesia Thailand Philippines Rep. of Korea Sri Lanka	Banned
Dicrotophos	Indonesia	India	Not Registered
Disulfoton	Sri Lanka, Thailand	Bangladesh India	Phased out
Endosulfan	Bangladesh Thailand Sri Lanka	—	Restricted
* Endrin	—	All 9 countries	Banned
EPN	—	India Philippines	Not Registered
Ethoprop	Philippines	—	Not Registered
* Ethylparathion	Rep. of Korea	Bangladesh India Malaysia Indonesia Pakistan Sri Lanka Philippines	Banned
* Ethylene Dibromide	Philippines	Indonesia	Not Registered
Leptophos	—	All 9 countries	Banned
Lindane	Thailand	Bangladesh	Restricted

Pesticides	Restricted in	Banned in	Status in Sri Lanka in 1987
Methamiddophos	Indonesia Sri Lanka	—	Restricted
Methomyl	Sri Lanka	Malaysia	Restricted
Methyl Bromide	Indonesia Philippines Sri Lanka Rep. of Korea	—	Restricted
Methylite Parathion	—	Bangladesh Sri Lanka	Banned
Monocrotophos	Indonesia Malaysia Sri Lanka	—	Restricted
Mephosfolan	—	India	Not Registered
Nitrofen	—	Philippines	Not Registered
Phenamiphos	Philippines Sri Lanka	—	Restricted
Phorate	—	Bangladesh	Not Registered
Toxaphene	—	Indonesia Thailand Philippines India	Not Registered
* 2,4D	Sri Lanka	—	Restricted
2,4 5–T	Philippines	Indonesia Thailand Sri Lanka India	Banned

Pesticides	Restricted in	Banned in	Status in Sri Lanka in 1987
* Paraquat	Bangladesh Indonesia Philippines Sri Lanka	——	Restricted
Mercuric Fungicides	Sri Lanka	Philippines Rep. of Korea	Phased out

1. Pesticide Action Network based in Malaysia (group of non-government bodies from 16 countries)

* 'The Dirty Dozen' – Indicated as the most hazardous for Third World countries.

Annexure IV

LIST OF RESTRICTED AGRO-PESTICIDES 1987

HIGLY TOXIC AGROCHEMICALS

A. Insecticides	Sold by Registered Dealers	Sold to Certified Applicators
Aldicarb	–	+
Aldrin	+	–
Aluminium phosphide	–	+
BHC	+	–
Chlordane	–	–
1,2–Dichloropropane (plus)	+	–
1,3–Dichloropane		
Hydrocyanic Acid	–	+
Magnesium Phosphide	–	+
Methamidophos	+	–
Methomyl	+	–
Methyl Bromide	+	+
Monocrotophos	+	–
Omethoate	+	–
Oxydemeton-Methyl	+	–
B. Herbicides		
Paraquat	+	–

POTENTIALLY CARCINOGENIC COMPOUNDS

A. Insecticides		
Dimethoate		–

	Sold by Registered dealers	Sold to Certified Applicators
B. Fungicides		
Benomyl	+	–
Captafol	+	–
Captan	+	–
Mancozeb	+	–
Metalaxyl + Mancozeb	+	–
Thiram	+	–
C. Herbicides		
2, 4–D+Piperophos	+	–
2, 4 D	+	–
FOR OTHER TECHNICAL REASONS		
A. Insecticides		
Carbosulfan	+	
Cyfluthrin	+	
Deltamethrin	+	
Endosulfan	+	–
Fenamiphos	+	–
Fenvalarate	+	–
Permethrin	+	–
B. Fungicides		
PCNB (Quintozene)	+	–
TCMTB – MTC		
C. Herbicides		
Butralin	+	–

Annexure V

Table I Selection of pesticides

Method of selection	% farmers (Districtwise)			
	Kandy	Matale	N'Eliya	Badulla
Consult village level extension officers	37.5	23.8	21.1	7.9
Consult dealers	20.8	20.6	8.9	12.7
Consult neighbouring farmers	4.2	4.8	1.1	4.0
Own experience	31.9	36.5	46.7	55.6

Table II Devices used to measure pesticides

Measuring device	% farmers (Districtwise)			
	Kandy	Matale	N'Eliya	Badulla
Specific container	10.1	39.3	26.7	7.9
Lid of pesticide bottle	46.4	50.8	51.1	54.0
Arbitrary measurement or no measuring	43.5	4.9	16.6	17.5

Table III Pesticide dosages used by farmers

Dosage	% farmers (Districtwise)			
	Kandy	Matale	N'Eliya	Badulla
Recommended	40.3	27.9	24.7	14.3
More than recommended	49.3	59.0	56.2	63.5
Less than recommended	4.5	3.3	3.4	9.5
Not known	5.9	9.8	15.7	12.7

Table IV **Pesticide application**

Time of application	% farmers (Districtwise)			
	Kandy	Matale	N'Eliya	Badulla
Before appearance of pests	39.4	62.9	66.7	85.7
After appearance of pests	45.1	29.0	24.4	9.5
Before or after appearance of pests	15.4	8.1	8.9	4.8

Table V **Pre-harvest intervals**

Pre-harvest interval	% farmers (Districtwise)			
	Kandy	Matale	N'Eliya	Badulla
More than 14 days	11.4	4.8	31.5	10.3
7–14 days	51.4	50.8	61.8	50.0
Less than 7 days	37.2	44.4	6.7	39.7

Table VI **Pesticide poisoning due to the application of pesticides**

(Deaths due to suicide are not included)

District	No. of farmers hospitalized	No. of farmers dead
Kandy	5	2
Matale	14	3
Nuwara Eliya	16	5
Badulla	9	Nil

INVASION OF CHEMICALS INTO THIRD WORLD COUNTRIES

by

Dr. S.N. de S. Seneviratne

Over the years, in Sri Lanka, as in other countries, major changes have been effected on the land surface and a variety of land use systems and agricultural practices adopted to produce crops for export or domestic use. Up in the hills, the montane temperate forests occupied the land as a luxurious vegetation cover composed of a diversity of plant species. Thousands of such species formed a rich community, growing together, protecting the community as a whole and the land in which they were rooted. However, with the development of crop husbandry, a new system of plant culture was to be practiced in land previously covered by natural vegetation. In the new system, a single crop was to dominate the land denuded of its original plant cover. In Sri Lanka, coffee, tea, rubber and coconut were to take its place as constituents of the country's plantation agriculture.

Early in the history of this developing plantation industry, a stunning demonstration of the hazards that monocultures are subject to, was given by a fungal pathogen, Hemileia vastatrix, the coffee rust fungus, when it devastated Ceylon's nascent coffee industry. The system of monoculture, in as much as it enables economically attractive returns when mainly favourable conditions prevail, is also vulnerable to catastrophic reverses should adverse factors, among them pests and diseases, strike. Normally, in plantation agriculture, one or a few varieties or cultivars of a particular crop plant are cultivated. Thus, a potential pest or pathogen has unimpeded access to innumerable potential victims - crop plants - under conditions favouring their multiplication and activity. It happened with coffee during the rust epidemic; it happened with tea when the blister blight fungus, Exobasidium vexans, arrived in this country. It happened with coconut when orchid merchants smuggled that illegal immigrant, Promecotheca cumingii into the island, and it is happening now as Corynespora cassiicola ravages the prized rubber clone, the hope of many years of patient research, RRIC 103. The ability of crop plants to withstand such attacks is not always adequate - they succumb to the pressures of pests and pathogens. In such situations, appropriate methods have to be adopted to combat the problems posed, and one of these methods is recourse to agro-chemicals, effective in containing or controlling the agents encountered and responsible for the crop damage. The more desirable alternative, of course, is the cultivation of varieties resistant or tolerant of economically important pests and pathogens. The search for such varieties and the breeding of new ones is a continuous research activity. Yet, pests and pathogens are deadly adversaries. New forms or more virulent strains or variants may arise or be introduced, able to attack the resistant or tolerant cultivars. It is in this context that agro-chemicals must be considered as a necessary and useful protective measure, with a place in plantation agriculture, as well as in other forms of crop husbandry. However, that recognition in no way implies justification of the frivolous resort to chemicals, their unregulated application or the aggressive marketing practices commonly adopted.

In the perception of a concerned layman observing the use of agro-chemicals in the plantation sector, their role has not been regarded as purely protective and beneficial. The alarm has been sounded in a troubled mind, the entry of chemicals into the Third World seen as an invasion. Yes, "invasion" is, in this context, a word almost synonymous with another cruder word, "dumping", which signifies a stark reality in Third World countries. For the Third World is the dumping ground of great loads of refuse and sub-standard produce from countries in the great West as well as the Far East in the realization of unconscionable profits for industrialists, regardless of the privation that such greed may cause. The multinationals operating the sick industry flood this Third World country, like others, with an assortment of pills, capsules and drops, not all pure or potent or safe. In the case of agro-chemicals too, the so-called Third World, is the dumping ground of a variety of products including those of questionable composition, and others prohibited in "developed countries", which are freely exported to the Third World countries by the giants of the great free world, which the agro-chemical industrialists are ever willing to produce, sell and export. It is big business and the stakes are high. Even in the country of origin concerned scientists and organizations are striving to influence the formulation of rational policies

and practices in the use of pesticides. Those who recognise the health hazards associated with toxic chemicals, who are alarmed by the wholesale destruction of innumerable living species, necessary to maintain some kind of biological balance, by the excessive use of pesticides; who are conscious of the emergence of pesticide resistant biotypes and strains consequent to the widespread application of chemicals; who are concerned about the adverse effects of pesticides on the environment, these scientists and organizations are fighting an unequal war. That is true of the Environmental Protection Agency (EPA) in the United States; it is true of regulatory bodies in other countries too. There is a pesticide mafia which has few scruples. The wolves are on the prowl, ever ready to pounce. The pesticide mafia has bought politicians, bureaucrats, policy-makers, administrators, directors, deans, doctors, researchers, entomologists, plant pathologists, weed scientists, toxicologists, journalists, media men and the lot to satisfy its greed for enormous profits that agri-business can secure. Even lawyers are hired to persuade judges and jury that the villains are the "conservatives", or inept farmers who do not know how to use pesticides, correctly.

In the United Kingdom, the safety precautions scheme of the Ministry of Agriculture, has been described as a "toothless watch-dog" by the environmental group, Friends of the Earth, which researched Britain's agro-chemical industry. It accused the industry of using unscrupulous marketing methods to oversell insecticides, fungicides and herbicides. In a twenty-five year period from 1940 to 1975, pesticide sales rose dramatically in the UK from about 10 million pounds sterling worth to 143 million pounds sterling worth. By 1976, about half these sales were to markets overseas.

What I have tried to stress is that given the monoculture situation of plantations and the vulnerability of crops, to attack by pests and pathogens under conditions favourable for their activity, pesticides have a role in the system of crop protection; also, that pesticides constitute a lucrative commercial enterprise in which manufacturers often adopt unscrupulous methods to sell their products, and that pesticides banned in developed countries on account of their health hazards are freely available for sale in the under-developed world.

Sri Lanka too is a developing economy, yet, it will not be correct to persuade ourselves that the country is invaded by chemicals. The word "invasion" signifies aggression, an act executed without the participation or consent of the victim. Chemicals, for the most part, enter a country with the knowledge and acquiescence of its government and with the participation, collusion and involvement of its nationals. An episode from Alex Haley's book "Roots", is illustrative.

> "Why do we count only those taken away by the toubob?".... "We must count also the burned baobabs where villages once stood. He has killed more in fires and in fighting him than he has ever taken away!"
>
> "Toubob could never do this without help from our own people. Mandinkas, Fulas, Wolofs, Jolas - none of the Gambia's tribes is without its slatee traitors ....."
>
> "For toubob money, we turn against our own kind,".... Greed and treason - these are the things toubob has given us in exchange for those he has stolen away." "

What is happening in Third World countries today is merely a variant of what happened in the African continent with the slave trade. Money and greed are powerful motivators; and the entry of and broadcast use of agro-chemicals in Third World countries takes place with the help "from our own people." The roles of the tribes of The Gambia - Mandinkas, Fulas, Wolofs, Jolas - are played by bureaucrats, technocrats, regulators and distributors in Third World countries! It is well to recognise the underlying causes of our ills, in Sri Lanka too.

The fact is that Third World countries like ours are trapped in the mires they have walked into and are caught up in the consequences of their own indiscretions. Third World countries are poor countries. Their people breed too fast. Their rulers have squandered national resources. There are chronic food shortages, even starvation. They are immersed in debt. The remedies are prescribed - grow more food to feed the starving millions; produce more agricultural commodities for export - to earn valuable foreign exchange. There is no dispute at all that these are wholly laudable objectives. Yet, the crucial consideration is expressed in the word that

has recently come into prominence - "modalities". Increased crop production is not synonymous with bathing plants with pesticides, soaking the ground with them, polluting the waterways, and poisoning the environment.

Some components of the defence system against this invasion by chemicals:

(1) The correct order of national priorities.

Agriculture, industry, health, education, Air Lanka, stadiums, state drives, all make their claims. Those who hold the destiny of Third World countries like ours, cannot abandon their obligation and responsibility to think, plan and provide. They must not delegate that responsibility to "money-lenders", to those with vested interests in our agricultural sector, or to those who may not or cannot appreciate aspects relevant to our situation, both in the short term as well as in the long term. Let priorities be determined with a concerned awareness of our condition, and sensible strategies evolved to meet the problems confronting us. Here, the record is a dismal one. We have been "lotus-eaters" in our island paradise. A deep concern for the essentials to ensure the well-being of our agricultural system has been wanting. Status symbols and grandiose schemes seem to have precedence over institutions and activities vital for our economic survival and social well-being. Agriculture is the corner stone on which the economy of this country has to be built. The agricultural enterprise must be sustained by research and services which must be adequately supported and wisely administered. The motivation of those engaged in these tasks must be stimulated, their morale sustained and staff stability ensured. In such a situation, it will not be beyond the ingenuity of our researchers to fashion crop protection measures which will not rely so heavily on hazardous pesticides. The chemical invasion can be stalled. It is not enough to compile statistics of the foreign exchange earned by export of agricultural commodities, or of the foreign exchange saved on account of the food produced locally obviating the need for imports. A part of the wealth thus generated must be returned to the agricultural enterprise, to maintain the agricultural sector in a buoyant condition, to provide the facilities it needs, and to reward the "geese that lay the golden eggs"

These things don't seem to register, only when catastrophe strikes do the supreme powers address themselves to matters long neglected. A crop devastation by pest or disease, an earthslip or flood, or ethnic strife and terrorism are catalysts that trigger reactions.

Let me illustrate with examples relevant to the present chemical concerns. The presentation to Parliament of the "Control of Pesticides Law" was delayed over many years - because this legislation received such low priority. Even after the passage of the law, deficiencies in implementing it including the technical capability to provide back-up services remain. The Government Analyst's Department, which has the responsibility to conduct chemical analyses, is hopelessly constrained by inadequate laboratory space and facilities.

(2) A greater emphasis on strategies and techniques that could reduce the opportunity for the invasion by chemicals

There was once a balance in nature until man, (the most arrogant animal to colonize the earth) tampered with the systems that nature had ordained. Yet, even in relatively recent times the farmer in this country had recognised ways and means of overcoming the consequences of tampering with nature, when his food production activities compelled him to adopt practices of monoculture. Let me illustrate: We, in the Division of Plant Pathology at the Central Agricultural Research Institute, research on plant diseases. One of my younger colleagues has obtained some interesting results in recent work. The older generation of farmers (they were wiser too), traditionally used specific plants as green manure for particular crops. We have now discovered that some principle in Adhatoda vasica, a plant used as a green manure, inhibits the growth of a seed and soil-borne pathogen, Phytophthora vignae, and suppresses the reproductive activity of another pathogen, Pythium. butleri, which causes damping-off of many plant species. In other studies, it has been observed, that soil-inhabiting saprophytic fungi such as species of Aspergillus, Penicillium and Trichoderma have an inhibiting effect on species of seed-borne and soil surviving Alternaria, a pathogen which attacks crucifer vegetables and other crops. An investigation into the death of onion

seedlings in nurseries yielded some very interesting information. The affected seedlings were heavily colonised by the soil-dwelling fungus, Pythium. In the preparation of the nursery beds, a fungicide, Morut, had been applied to control diseases that might occur in nurseries. It did not. On the contrary, it induced a problem. Morut contains two chemicals, fenaminosulf and quintozene. The former is effective against Pythium but is a rather unstable chemical. The latter is ineffective against Pythium but kills other organisms in the soil microflora. Pythium was one of several fungi in the soil of the nursery beds, which interacted one with another. There were competitive and antagonistic effects among them. The effective chemical in Morut, quintozene, had eliminated or reduced the population of the competitors and antagonists from the microflora. Fenaminosulf, rendered ineffective by instability, had not been able to check the Pythium in the soil.Instead, more favourable conditions were created for the rapid increase of the Pythium population. This pathogen was produced in abundance as a consequence of the application of Morut and attacked the onion seedlings in the nurseries. So a chemical treatment, instead of controlling a disease, actually precipitated it. What holds true for the inter-relationships between pathogenic fungi and non-pathogens, holds true for pests too. Indeed, with insect pests, the situation is expressed more dramatically as the widespread and indiscriminate application of pesticides destroys natural enemies such as predators and parasites, which check the population of pests damaging to cultivated crops, and stimulates the development of pesticide resistant forms. So the prescription, the use of more deadly pesticides and greater frequencies of application do not cure the ills. Instead, they put up costs of crop production, increase environmental pollution, and may even cause effects to destroy an industry, as happenend with cotton in northeastern Mexico.

Intensive research must therefore, be directed towards the development of alternate systems of crop protection that take into account aspects which chemical control methods largely ignore the killing of non-target species, disruption of any possible biological balance in nature, the pollution of the environment, health hazards to agricultural workers as well 's consumers, and also, costs of production.

(3) The dismantling of "security cordons" around decision-makers.

When things go wrong, the responsibility is laid at the door of the Government of the day; the Minister in charge of a particular subject area is blamed for a calamity. Yet, what Ministers do and what Governments decide are often influenced by the security cordon consisting of advisers, bureaucrats, technocrats and academics, etc. Some of them are great peddlers of "dead-ropes". The syndicates of the privilegentsia, frequently air-borne, are not as much concerned about the country's interests as their own. So a trusting Minister can be persuaded that the stench arising from rotten potatoes is an act of God, or that kaha rogaya, a yellowing condition of rice crops that occurred in the Hambantota District is caused by a virus. Worse, the Cabinet may be advised to adopt measures dictated by falsehoods. In the case of "Kaha Rogaya", a yellowing condition of rice crops, the Cabinet approved Rs. 15 million to spray 50,000 acres of paddy in the Hambantota District, which according to a report in "The Island" of 15th December 1984, was "to counter the yellow disease now positively identified as a virus spread by brown plant hopper". This positive identification was made by a pressure group in which the key figures were a plant-breeder, a plant physiologist and a soil chemist. Dealers in agro-chemicals would certainly have been cheered by the prospect of the sale of Rs. 15 million worth of agro-chemicals, although the effects of this chemical in the Hambantota District would hardly have been for the greater good of the people there or the environment. A more "open" approach by top policy makers and highly placed decision-makers is necessary so that more information from sources other than the "security cordon" would be available to make more objective decisions. It may be argued that top advisers include scientists, qualified and experienced. Unfortunately, no longer can scientists or administrators or any other category be regarded as reliable advisers. Qualifications alone don't guarantee the character of the individual. It was Professor Karl Eric Knutsson who remarked that the kind of persons required are not those with minds only but with hearts as well. Alas, sometimes it is only after an individual is rushed off to a hospital with a suspected heart ailment or when he kicks the bucket that confirmation is obtained that he had a heart at all!

(4) Preventing situations leading to chemical invasions.

When a pest or disease strikes, the immediate reaction is to reach for the chemical that might "control" the causal agent - curing the ills if indeed they can be cured. But why is it that the prevention of such ills is played on a very low key? Right now, rubber is being devastated by a leaf disease caused by the fungus Corynespora cassiicola. It is a worrying thought as to whether this fungal strain is a variant that arose in this country or whether it has been introduced from elsewhere. If South American leaf blight were to be introduced here, the rubber industry will probably be doomed not only in Sri Lanka but in the Southeast Asian region as well. The agro-chemical lobby might come up with a bright idea - fungicides might be sprayed to control the fungus. Why not modernize plant protection by securing aircraft for the purpose? Why not indeed! Another private enterprise can be born! But such a course is simply not a practical proposition.

At Batalagoda, the country's premier rice breeding station, a bacterial disease, bacterial leaf blight caused by Xanthomonas oryzae, has broken out in epidemic proportions. We have had this disease for a long time but our strains of this pathogen have not been damaging. The bacterium is seed-borne and easily spread in irrigation water. Has seed been introduced to Batalagoda carrying a bacterial strain which can cause serious damage to local rice varieties? Rice blast, caused by the fungus Pyricularia oryzae, once caused serious damage to our rice crops. Although there are fungicides that can control the disease, adopting this option will be hopelessly unrealistic. A sustained programme to develop resistant varieties which can withstand the disease has resulted in the problem being brought well under control. The need for fungicides to combat the disease is minimal. But strains of the blast fungus present in Pakistan, if introduced to Sri Lanka, can dramatically change that situation with the introduced strains attacking the varieties locally cultivated. Fungicides to control the disease will then be sought. Such a situation will usher in a prosperous era for agro-chemical marketers but it will be a catastroph- for rice production.

Plant material, with the potential for crop destruction is entering the country as assuredly as drugs and illicit arms. Citrus is a favourite of illegal introducers. The importation of citrus vegetative material is prohibited by law. Over 15 virus and virus-like diseases, including the devastating disease Greening is transmitted in vegetative tissue - in bud wood and plants. Greening has ravaged citrus in the Southeast Asian region. There is nothing left of a model citrus orchard in Thailand which had over 30,000 trees. But illegal attempts to bring in citrus vegetative material into the country continue and there surely are successful introducers. Plant introducers imperil the country's agriculture because pest and disease agents not prevalent in Sri Lanka, or strains more devastating than those present in the country may be introduced with such imports. The entry of dangerous pests and pathogens might herald an economic boom for the agro-chemicals trade but cause catastrophic consequences for the country's agriculture. The chemical invasion into Sri Lanka is a distinct possibility! Plant quarantine is a defence strategy that might hold such invasions at bay. Unfortunately, Sri Lanka's Plant Quarantine Service is also like a "toothless watchdog".

(5) Banning some weapons of the invasion.

An invasion requires weapons. And there is a dazzling array of them now. The same principle, that not all deadly weapons invented are used, must be applied in selecting chemicals to combat pests, diseases and weeds. Some should not be used at all.

The International Pesticides Action Network (PAN) based in Malaysia composed of non-government groups from 16 countries have identified a "Dirty Dozen" of chemical pesticides. PAN International has called for a ban on "their manufacture, sales, use or trade". These 12 pesticides have been selected "not only for their toxicity but also for the hazards they pose to people in Third World countries". The 12 are:

2,4,5-T, Aldrin (including Dieldrin and Endrin), BHC/Lindane, Camphechlor, Chlordane (Heptachlor), Chlordimephorm, DBCP, DDT, Ethylene Dibromide, Paraquat, Parathion and Pentachlorophenol. Now some of these are known in the local scene - Aldrin, Dieldrin, Endrin, BHC, DDT, Paraquat, Parathion - although some of them are no longer recommended in Sri Lanka.

However, Paraquat formulated as Grammaxone is used in the plantation sector and elsewhere. Just as much as it is standard practice in some places to dip vegetables in insecticide solutions before delivery to the mudalali, it is a practice adopted by some traders to treat green gram with the DDT formulation Gannaxene. Is it not time to slam the ban on them in Sri Lanka?

Even if properly used, according to instructions, pesticides are not without their hazards. The bottle glass on my spectacles, aids after two eye operations, may well be the demonstration of the hazards of pesticides encountered by researchers with chemicals. Some chemicals are particularly hazardous, the cumulative poisons, those that are carcinogenic or mutagenic. When mercury fungicides were manufactured in Japan and human contamination occurred, several years elapsed before the Minamata disease appeared in its terrible form. It may take 20 - 30 years before cancers appear in persons exposed to carcinogenic agents; mutations are detected generations after exposure to a mutagen. It is an inescapable responsibility to arrive at decisions and implement schemes taking into account all the information available. Think also of the wretched of the agricultural earth, the plantation and estate labourers and the farm workers, lowly mortals, who will be most exposed the chemical pesticides - whose task it is to apply them. The consequences of the hazards they are exposed to may not be immediately felt; but they will be experienced years later in sickness, infirmity and premature death. There can be little solace for the bereaved in invoking the blessings of the Gods after men are dead, whatever the cost of the ceremonial.

The perceived invasion demands the utmost commitment on the part of the potential victims - to hold the enemy at bay. This is true in the case of chemicals too - the invaders in the topic given to me for this address. And that invasion must also generate the response appropriate to the dangers implicit in an invasion, which more than all else must be determined by a commitment to humanity than by less honourable considerations, the huge profits that they generate for the barons in the pesticide industry.

RESPONSIBILITIES OF ESTATE MEDICAL ASSISTANTS

by

S. S. Rajendran

Estate Medical Assistants attached to the plantation sector are expected to carry out both preventive and curative work in the areas of community medicine, family planning, housing, maternal and child health, immunization, ante-natal and post-natal care.

These officers face several problems in the course of their work. The estate dispensaries not only have a limited stock of drugs, in many instances, they do not have even the essential drugs. Due to the shortage of drugs and lack of other facilities many of the patients are transferred to nearby government hospitals without prompt treatment.

A study on the use of pesticides and the occurrence of occupational and other forms of poisoning, was carried out by me in thirteen estates in the Hatton region. Some of these estates were managed by Sri Lanka State Plantations Corporation and others by Janatha Estates Development Board. The study revealed that:

1) 10 estates had qualified Estate Medical Assistants and the other 3 remaining estates had Junior Estate Medical Assistants,

2) records with regard to poisoning cases were scanty,

3) there were only 18 cases of deaths in the plantation sector due to pesticides. These deaths were suicides. There were no records or reports of deaths due to occupational poisoning,

4) management in the plantations knew very little about the dangers of these pesticides and the seriousness of prolonged exposure to these pesticides, particularly during spraying and other forms of handling.

The following data were collected during the study in the use of pesticides:

a) Grammaxone or Paraquat - as a weedicide
b) Methyl Bromide - for soil preservation or fumigation
c) Copper oxychloride - for Blister blight.

Other pesticides were also used.
The labour employed for spraying was one man per 10 hectare.

Incidents reported from 13 plantations from use of pesticides since 1980, were:

a) Poisoning due to suicidal attempts	67
b) Deaths (suicides)	47
c) Deaths due to contamination and exposure at <u>non-occupational</u> level	18
d) Deaths due to poisoning when spraying <u>occupational</u> - (no records were available)	
e) Cases reported at out-patients departments of government hospitals with a history of poisoning	190
f) Treatment at estate level	149

No deaths of workers due to pesticides have been reported or recorded in the course of their work (occupational).

The average age group of persons who used pesticides for suicidal purposes was between 15-25 years. The exceptions were 2 adults of the age group 30-45.

GENERAL OBSERVATIONS

All the plantations in Sri Lanka use pesticides extensively. There has been a 50% increase in the use of pesticides when compared to the 1970 figures. At an interview with the Superintendent of an estate it was revealed that the pest problem had aggravated due to deforestation and other ecological changes, and therefore they had no alternative but to use pesticides.

The field survey of the use of pesticides in a few plantations revealed that:

a) selection of labour for spraying is done by the field officer and there is no pre-requisite qualification,

b) in many instances the labour force involved in spraying were not given a proper training or were not properly instructed on the methods of spraying. However, a few labourers were able to explain the dilution used and the adverse effects of bad handling,

c) no proper protective clothing were worn. A few labourers wore thick khaki coats and caps made of denim cloth. Most of them wore shorts but no foot-wear,

d) 9 spray units out of the 16 used by the labourers were found to be defective. Most of the spray units leaked from the rubber hose,

e) one labourer in this group of 16 labourers was given the task of mixing the pesticides with the diluent (generally water). He was not a trained person and he wore no protective clothing. He was given a plastic measuring cup and a 20 gallon container containing the pesticide. He used his unprotected left arm to mix the pesticide with the diluent and later washed the arm with cold water. He did not use a stick for mixing,

f) the water was taken from a streamlet which subsequently flowed past a row of line-rooms where there were 120 dwellers,

g) there was also a supervisor at the time of spraying, although he too was not better informed than the labour force in the safe use and handling of pesticides. Neither did he wear any protective clothing,

h) the spraying started around 7:45 a.m. and ended at 12:00 noon. The labourers were not provided with soap although the previous management had done so,

i) the pesticide sprayed more often was Grammaxone, a weedicide banned in some countries,

j) when the labourers were asked whether anyone felt sick or had any uncomfortable feeling, they answered that on some occasions they had a feeling of dizziness or nausea which disappeared when they rested for a while.

STORAGE AND ISSUE OF PESTICIDES

Most of the plantations stored the pesticides with other general stores like paints, electrical goods, tools and so on. In one case the pesticide was stored along with food items. Storing pesticides in this manner was due to lack of space. The Management had instructed the storekeepers not to issue pesticides to persons who carried empty green leaf bags from the factory to the Divisions, but this was generally not observed as it was convenient to carry out the dual task on one trip.

DATA COLLECTED FROM ESTATE MEDICAL ASSISTANTS

Many Estate Medical Assistants had few or no patients with complaints of:

nausea and vomiting
giddiness
dim vision
lack of concentration
abdominal pain.

These are symptoms developed when exposed to pesticides. The persons who had these symptoms were either treated at the estate level by giving some form of antidote or sent to the nearest government hospital. There were 32 such cases from the 13 plantations investigated and 9 of these cases were referred to government hospitals.

SUGGESTIONS

From the study of the 13 plantations it was found that there was very little awareness of the dangers of pesticides at all levels in the estates, therefore, there are a few suggestions which would be beneficial:

1) All Estate Medical Assistants, Field officers and Trade Union leaders and Management be made aware of the dangers, particularly the long term effects of pesticide poisoning.

2) Regular seminars and workshops should be organized to educate the people working in the estates on the correct use and the dangers of pesticides.

3) A basic training on use of pesticides in the area of handling, mixing and spraying be given to estate supervisory staff so that they could give correct instructions to the labour force.

4) It is advisable that the Assistant Superintendent be present when the dilution and mixing of the pesticide is carried out.

5) Protective clothing recommended by the Labour Department should be provided and every effort must be made to get the sprayers to wear these.

6) An Estate Medical Assistant and a Trade Union leader from each estate may be appointed to check whether the requirements are met. They may visit the estate at regular intervals.

7) Separate stores facilities should be provided to store pesticides. Pesticides should never be stored with foodstuffs.

8) Sufficient stocks of antidotes and drugs needed for an emergency should be supplied to estate dispensaries.

9) Regular checks should be carried out on spray equipment for defects or leaks. No defective equipment should be used.

10) Pesticides should be transported with care. They should be so wrapped in polythene pouches to avoid spillage during transport from stores to field. Pesticides should not be transported with green leaf (tea) from the field, or with foodstuffs.

11) Extension officers in the Department of Agriculture who are also Authorized Officers under the Pesticides Act should visit the estates.

12) All Estate Medical Assistants should get themselves involved in addition to their normal work, to advise the estates on the proper handling and use of pesticides.

14) The Advisory Committee which has been formed as a result of this seminar should advise the estate staff.

15) The "Poison Centre" set up by Dr. Ravindra Fernando in the General Hospital Colombo, will be very useful to the staff -'particularly Estate Medical Assistants.

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